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# Editorial Comments.

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## IMPROVEMENTS AT CHERBOURG.

Cherbourg is situated at the northern end of the Cotentin peninsula on the English Channel, half-way from the Atlantic Ocean and the North Sea.

Opposite to the Isle of Wight, which protects the access to the British Harbour of Southampton, Cherbourg is obligatorily on the way of the trans-Atlantic liners running between North and South America to the ports of the South of England as well as to the French harbours of the Channel and the foreign ports of the North Sea.

Cherbourg is connected with Paris with a double rail track and a well-frequented national highway of about 360 kilometres. The roadstead, of an area of 15,000,000 square metres, spreads its waters between the point of Querqueville and the Isle Pelée, of about seven kilometres distant from each other.

Three breakwaters protect the roads: on the western part the Querqueville breakwater; in the centre the large breakwater of four kilometres length; and on the eastern side the Tourlaville breakwater, leaving a channel at the west 1,100 metres wide with depths of 12 metres at the lowest tides, and one channel at the east 700 metres wide, with, at its entry, a depth of eight metres at lowest tides.

The principal road presents, on its largest area, depths varying from 13 to 14 metres. Its access is of the easiest type, and always possible, even in rough gales. The sand and muddy banks are excellent, as well as the holding at anchor of the ships. The currents, at the entrance as well as inside of the roads, are very weak and are of no inconvenience to the navigation.

The principal roads communicate with the small ones (from which they are separated by the breakwaters of Le Homet and of Les Flamands) with a 500 metres channel between the two.

The small roads give access at the west to the Military Harbour, and at the south to the Port of Commerce, through a channel limited by two jetties running north—south. At the east will soon appear the docks of the deep-water harbour actually under construction, and which will transform the small roads into a real interior harbour.

The geographical situation and the exceptional access, situation and protection of the Port of Cherbourg and of its roads have, since the last century, attracted the attention of the steamship companies. Immediately before the war, under the impulsive competition arising between the British and Germans, the Cherbourg roads yearly received more than 500 liners' calls, representing 4,500,000 tons, with more than 70,000 passengers.

Actually, the traffic rises to nearly 900 liners calling, with a total of some 200,000 passengers. It is not uncommon to see simultaneously in Cherbourg roads three or four liners making their call.

The ships anchor inside the roads. The passengers and baggage are transhipped on some tenders specially equipped to that effect and approach leeward alongside the ships, which are themselves protected by the breakwaters. The clearance takes place in all kinds of weather with the greatest speed.

The tenders transport the passengers to the Quay Station, situated on the eastern side of the Commercial Harbour, and where the special trains are ready to go to Paris or to Central Europe. The Quay Station, improved since the war, is composed of a main saloon with all offices and necessary services, Custom sheds well fitted, where the clearing operations take place rapidly. The passengers in that station can obtain all commodities they may require.

The improving and extending works nearing completion aim at a triple effect: to further improve the calls made with the use of tenders, to permit the calls of steamers wishing to come direct alongside the quays, and to permit the utilisation of the Port of Cherbourg as European home port for trans-Atlantic lines.

These works comprise:—

The construction, already achieved, of an inside breakwater protecting the small roads against the effects of the eastern winds, and a mole of 100,000 square metres area, prolonging towards the north the eastern part of the Commercial Harbour.

The construction on that mole of a new quay station, and against the eastern side of a quay wall of 640 metres length at great depth.

The building at 230 metres to the east of the preceding quay wall, a second mole, and on its western side by another second quay wall of 640 metres length of great depth.

The dredging at 14.00 metres (less 14 metres at lowest tides) of the dock comprised between the two moles, and the creation, between the dock and the entrance of the small roads, of a swinging ground where the liners can easily manoeuvre with depths varying from 14.00 metres at the junction with the dock, and at 11.00 metres at the junction with the entrance of the small roads.

The new Quay Station will include a principal building with upper floors and wings, of 240 metres length and 42 metres width, with a tower 60 metres high, a hall 240 metres in length and 15 metres width, covering the roadway; a hall 240 metres in length and about 39 metres wide in a single arch above the rail tracks where the passengers will board the train.

On the ground floor of the building there will be a network of five rail tracks for the housing of the boat trains, and rails along the quay for the baggage and postal services.

Equipment will include installations for the easy transfer of passengers from the first floor of the Quay Station to the tender or aboard the liner when alongside the quay, and vice versa, and for the transhipment of the baggage and sacks of mail.

The principal building will be disposed so as to permit the clearance of four important calls at the same time. This building will comprise, duly enlarged and numerically increased, all the installations existing in the present Quay Station, and will make the new station at Cherbourg a leading building of its character both in France and abroad.

This new Quay Station will be connected to the Paris-Cherbourg rail line by a double track specially independent of the Cherbourg Rail Depot; also to the town of Cherbourg and to the national road from Cherbourg to Paris, so that there will be very easy and safe access and clearance.

Simultaneously to the construction of the new Quay Station will be built the two quays in deep water and the dock at 14.00 metres. This dock is being dredged at 5.00 metres on 125 metres width.

Immediately after, the second mole will be provided with the necessary handling plant (cranes, mechanical conveyors, etc.), sheds and rail tracks.

In the near future Cherbourg will possess quays alongside of which steamers of a draft of 11 metres will be able to dock at any time. A first steamer berth will be ready at the end of this year. Ships of 14 metres draft will be able to come alongside at half-tide and stay there with no fear of going aground. The dock, of a width superior to the width of the Southampton river, with quay walls in deep water, drawn into the direction of the dock, will always permit of easy docking and departure. Thus equipped, the Port of Cherbourg will meet all requirements.

For liners desiring to come alongside the quay, a deep-water quay will be available, with access at any time of the tide and whatever the weather conditions. The number of tugs will be reduced to the minimum, and powerful tugs from the French Navy could be utilised in exceptional cases. A modern Quay Station, powerfully equipped, will permit the rapid and comfortable transfer of passengers from the liners to the special trains or to the motor-cars de luxe.

To the liners desiring to make Cherbourg their European home-port, there will be offered, alongside the first mole, the

same advantage of access and landing facilities for passengers, and alongside the second mole facilities for stationing and revictualling. Sheds and portable water stations will be erected to this end. The fuel oil will be secured by means of cistern-barges that the Fuel Oil Companies intend putting into service.

And to the ships preferring clearance by way of tenders the Port of Cherbourg will continue to offer its fine roads, which permit of transhipment in the shortest possible time. At present, when the rapidity of communications is of the highest importance, this facility is not to be neglected, and the actual favour of—from quay to quay—will perhaps be counterbalanced in a near future by the advantage of a prompt crossing, which the clearance by way of tenders alone will offer, as the German Steamship Companies so well understood before the War.

The roads will permit transhipment promptly and safely from the liners to the hydroplanes, which will take to Paris the passengers who cannot wait until the ship docks alongside the quay.

The British Air Companies are considering the possibility of the necessary connection, and the Port of Cherbourg does its best to develop this intention by facilitating, in particular, to the erection of airplane stations.

The Port of Cherbourg, which is actually the first port of call of the Continent, will thus keep its front rank on account of all the unique and exceptional facilities it will offer in meeting the present and future requirements of the Steamship Companies.

## CANADIAN CUSTOMS REGULATIONS.

Under Section 16 of The Customs Act, the master of every vessel coming from any port or place out of Canada, and entering any port in Canada, shall make a report in writing of the arrival and voyage of such vessel, and Form A-6 calls for information as to the voyage under explanatory instruction (3) reading " Port and Country Whence Arrived."

The Department of National Revenue, Canada, in a circular of January 4th, 1928, holds that this question is not satisfactorily answered by the indefinite statement that the vessel came "From the high seas," but that instead the intention of the Act was to require a statement showing a definite place from which the ship had cleared.

In future, therefore, Customs authorities are directed to require the masters of vessels reporting inward to name the port and country where last clearance was obtained and to give all information called for in Sub-section 2 of Section 16 of the Act, especially in respect of any addition to, change in, or disposition of cargo since the date of such clearance, whether occurring at any other place or at sea, using a special affidavit for that purpose if the affidavit printed with Form A-6 cannot be altered to suit the facts.

In all cases where the cargo on such clearance was intoxicating liquor the special affidavit should show the date and as nearly as possible the exact location of the vessel when transfer, if any, made and the name of the vessel to which the liquor was transferred.

## THE PORT OF CONSTANZA.

The Port of Constanza, the third of the series of articles on Rumanian ports, by Commissioner R. S. MacElwee, constitutes the subject of the inset supplement and also a special illustrated plate in the text showing typical sections of the main breakwater.

Constanza is in all respects the chief port of Rumania and as the author points out the only strictly sea-port. The extensive railway connections, of which some indication is afforded by the supplement, especially fit it as a great centre for inland transportation and in consequence it conveys the greatest passenger traffic in the country. Its record in late years has been one of striking progress and cargo handled in 1926 totalled 1,806,000 metric tons, a considerable proportion of which was petroleum, for the handling of which commodity the port is eminiently well equipped.

In the course of his article, Mr. MacElwee gives full details of the berths and quays available for the service of shipping, together with an account of the extension plans. Modern engineering practice is being followed in the port to the fullest possible extent and it is specially noteworthy that the scheme of improvements includes three full width quay piers, 300 metres long by 100 metres wide. These quays will each have four berths, 125 metres in length and are designed to include two railroad tracks on each quay, a central traffic road and two transit sheds for each berth. In all the new harbour will afford fifty more berths for vessels of large size.

## PORT OF GOTHENBURG IMPROVEMENTS.

Improvements to be carried out at the Port of Gothenburg during 1928 include the laying out of a new shunting yard with a length of track amounting to 12,000 yards.

The new sheds will be built in the Free Harbour; one a two-storey structure with a floor space of 65,000 sq. ft., for general cargo, and the other with a floor space of 22,000 sq. ft. for storing automobiles.

A new floating crane of 6 tons lifting capacity is being built. The crane is chiefly intended for coal and other bulk goods.

Two lighthouses are to be built outside the entrance to the port. They will be known respectively as the Gäveskä, and Knippelholmen, and will be provided with modern fog signalling equipment.

Other improvements include the reconstruction and deepening to 5.8 metres of the quay alongside the city gas works. The quay is also used for general traffic, mainly coal and coke.

## DREDGING AND DREDGING APPLIANCES.

The business of maintaining clear and deep channels in harbours, rivers and canals is so paramount a duty of Port Authorities, Conservancy Boards and Canal Companies that authoritative literature on the subject has a particularly strong ground of appeal to the personnel of these bodies.

A volume worthy of special notice is " Dredging and Dredging Appliances," by Mr. P. M. Dekker, of the Hague, which embodies some of the fruits of forty years observation and experience in this field of engineering.

The plant considered is placed in two main divisions:

(a) Machinery applied to the purpose of dredging under water and bringing the material to the surface, comprising bucket dredgers and suction dredgers.

(b) Excavators and elevators for the excavation or removal of soil on dry land.

The grab dredger has the distinction of doing duty in both spheres of work.

Mr. Dekker claims very reasonably that the greatest development in dredgers has taken place in England and Holland, with individual characteristics evolved to meet the widely different soils of the two countries, recognising that Germany too has done a certain amount of dredger construction. The heavier build of the English dredger is explained by the more intractable nature of the material to be removed.

The bag and spoon comes in for consideration as one of the earliest types of dredging apparatus, a method still of considerable value under restricted conditions as in narrow and shallow channels and dykes. An old print dated 1565 shows a group of three boatmen conducting operations on these lines.

A later print of 1650 shows a more elaborate type of dredger with two big operating wheels mounted on the vessel, one amidships and the smaller one, aft. The centre wheel was worked by hand, the operator pushing it round by means of long spokes projecting through the rim. A series of buckets was caused to advance to the end of the vessel where the spoil was released down a chute into a separate lighter. From this picture it is adduced that the addition of a hinge and catch to empty the bucket was an early development. The view is advanced that the bag and spoon dredger is the origin of the excavator, especially the type known as the " iron man " used so much in the United States.

Reference is made to the epoch making advance in type exemplified by the dredgers built by Werf Conrad in 1884 for La Plata Harbour Works in the Argentine. Mr. Dekker avowedly concentrates on the work of Dutch makers and without a doubt his instances of progress at that period would find a close parallel in the records of contemporary English builders.

The first of the dredgers mentioned above was the *Ensenada* and this is illustrated in common with the *Buenos Ayres No.* 3, the sixth of the series. The latter was an entirely sea-worthy craft and was distinguished by the fact that it proceeded to its destination entirely under its own power. This showed that it was unnecessary to ship dredgers in parts and assemble them at their destination and greatly facilitated the delivery of such plant.

The appliance known as Jacob's Ladder comes under attention and reference is made to its utility in discharging sand from ships, conveying gravel from ships into railway trucks and coal direct from lighters into steamers.

In its course, the volume* surveys the development of the elevators, the suction dredger, auxiliary barges and tugs, the self-discharging suction hopper, the sand pump, suction pipes, force pump dredgers, barge discharging suction dredgers and cutter suction dredgers. Various patents are described including those of L. Smit and Zoon, Fruhling's System of mud-suction dredging and the Werf Conrad System. The American firm of Goedhart Bros. is cited in connection with the progress of cutter suction dredgers and details are given of Bates' and Robinson's cutters.

Sir Robert Hadfield recalls in the preface how the value of manganese steel for wearing parts, discovered by him in 1882, was revealed by some dredger pins made for the Dredger Department of Preston Corporation, Ribble Navigation. These were at first presumed lost but were found still in service fifteen months later and practically unworn, in contrast with the ordinary steel pins which had to be discarded after three month's use.

The photographs in Mr. Dekker's book are beyond reproach and at the end there is a most valuable series of dredger diagrams.

*Dredging and Dredging Appliances, by P. M. Dekker, Crosby Lockwood and Son, London, 36s.

# The Port of Hull.

## *Wool-handling Facilities at the Humber Port.*

### INTRODUCTION.

Since early times the historic Port of Hull has been the leading entrance to England on the north-east coast. Its importance in this respect largely arises through the character of its harbour located on the spacious waters of the Humber estuary with the North Sea forming a direct link with Germany, and the countries of Scandinavia and the Baltic. In more modern times the basis of its commerce has broadened, and its connections have been flung far beyond the coasts of Northern Europe to the distant corners of the world.

Exterior View of Wool Shed, King George Dock, Hull.

To-day, Hull has the distinction of being the third port of Britain. In the wool trade in particular the Humber Port is distinguished by a high reputation both in respect of volume of traffic and in speed of handling. Some idea of the magnitude of this trade is conveyed by the fact that in 1927 close on 450,000 bales were handled at Hull. The countries of origin of the bulk of the wool are Australia and New Zealand, although a certain amount is imported from South Africa.

### VOLUME OF TRADE.

The location of Hull as the nearest port to the Bradford area, where the woollen industry is centred, is an especially favourable one, which coupled with direct rail communication from the docks, makes for speed of distribution and general economy in delivery.

The appended table shows the imports of wool into Hull from 1923 onwards, the bulk of which came from the Dominions of Australia and New Zealand:—

| | | | | |
|---|---|---|---|---|
| 1923 | ... | ... | ... | 64,379 tons |
| 1924 | ... | ... | ... | 61,260 tons |
| 1925 | ... | ... | ... | 48,831 tons |
| 1926 | ... | ... | ... | 74,973 tons |

Consignments are generally made direct to manufacturers or agents, and in this respect the character of the trade differs from that at London, where the bulk of the wool handled is imported for sale.

### HANDLING METHODS.

The bale, which is the unit of cargo handled, is a tightly compressed oblong bundle wrapped in stout canvas sewn up with hempen thread and sometimes made additionally secure by bands formed of narrow strips of metal. The weight of the bale averages slightly over three hundredweights.

The chief method of handling from ship to quay is the roof crane, and in this connection it may be observed that all sheds located at the quayside at Hull are well equipped with these appliances. For conveying the bales from quay to shed the usual appliance is the long favoured wooden barrow, which may be conveniently loaded by two men, although the services of three are required if the bale is to be lifted any considerable height, as in stacking. The electric winch is also used with success where ship and shed location involve longer hauls.

Electric winches are also in extensive use. A number of the large two-storied quayside sheds are equipped with supports to carry the tackle, consisting of stout iron brackets set on the outside wall at the first storey and at the roof edge, the latter being known as catheads. The lower brackets projecting only about a third of the distance of the upper ones are also furnished with pulleys. Inside, an electric cable runs up from the winch through the top of the shed to a bobbin attached to the roof crane. Power is thus obtained from the electric supply laid on in the first instance direct to the roof cranes along the top of the building.

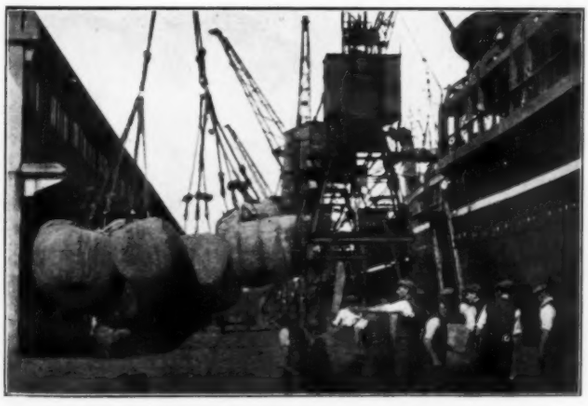
The winches themselves are in some cases fixed to a wooden base of massive construction shaped like the runners of a sleigh. At some of the sheds, however, the winches are mounted on wheels for movement where required. In cases where there are electric plugs in the walls of the lower storey, attachment from winch to power is made direct. The winches in use are those of Messrs. J. P. Hall & Son, Oldham, England.

Many of the sheds are equipped with sliding doors, right along each side, a feature of great convenience in short route handling from ship to storage. The usual practice inside sheds of this character is to leave a space of 3 ft. between wall and cargo in stacking the bales. Between 250 and 300 bales of wool are handled in a day by a gang of men working in conjunction with an electric winch, under favourable circumstances.

The stacking of bales necessitates a good deal of hand labour and is done most speedily when the consignment of wool is large and of uniform character. Bales are frequently transported in the warehouses by the patent 15 cwt. capacity electric runabout, which is made by Messrs. Ransomes, Sims and Jefferies, Ltd., Ipswich.

### SHED ACCOMMODATION.

The principal centres of the wool trade at Hull are the King George Dock and the Alexandra Dock, the main bulk being



The Quayside Cranes lowering Bales of Wool, prior to removal to Shed, on Wooden Barrows.

Bales being released from Crane Tackle. On the left, a Bale being wheeled away to Shed.

Discharging Australian Wool direct to Railway Waggon.

Another View of Quayside Equipment for Wool Handling.

dealt with at the former. Dock accommodation at Hull comprises 11 wet docks, with a water area of 232 acres, 2 riverside quays and 2 oil jetties, one in course of construction, occupying in all a frontage to the River Humber of about 7 miles; available quayage totals about 14 miles.

There are six sheds available for wool at the King George Dock, three at No. 1 Quay and three at No. 3 Quay. Speedy and economical handling is best effected where the consignment is large and uniform in character. In cases where the cargo consists of various grades, it is sorted at No. 4 Shed, King George Dock, which is specifically devoted to dealing with discrepancy bales.

The principal warehouse for legitimate storage is located about 300 ft. from the quayside near the Grain Silo, and is a spacious structure, built on the girder framework principle, with walls of galvanised iron and a glass paned roof. In the interior of 9 Shed, as it is called, there is room for 140,000 bales of wool, stored in tiers of 11 and 12 bales high. It is equipped with 15 cwt. electric runabout cranes which move anywhere at will under their own power.

Besides this special wool warehouse at the King George Dock additional storage is available as required, in other warehouses, affording a total accommodation for 200,000 bales. The sheds where wool is handled are conspicuously well equipped with roof and quayside cranes of 10 tons and 3 tons capacity and 10 ton elevators. The types of cranes in use are those of Messrs. Stothert & Pitt, Ltd., Bath; Messrs. Cowans, Sheldon & Co., Ltd., Carlisle; and Messrs. Royce & Co., Ltd., Manchester.

In conclusion, it should be noted that the main storage warehouse "Q," at King George Dock is furnished with railway track inside for the final loading of consignments. A valuable feature of the system lies in the fact that the rail lay-out permits of direct transport to consignee under unified control, the London and North Eastern Railway, which connects the port with the rest of the country, being also the owners and authority of the docks system.

## Isle of Wight.

### *New Vessel for Mainland and Island Service.*

James Pollock, Sons & Co., Limited, of London and Faversham, have recently delivered a twin screw motor vessel designed and built by them at their Faversham shipyard, to the order of Messrs. Shepard Bros., Ltd., Newport, Isle of Wight.

The "Bee," which will be running between the mainland and the island, is of the following dimensions:—Length (o.a.) 79 ft. 6 in.; length (b.p.), 75 ft.; breadth (mld.), 16 ft. 6 in.; depth (mld), 6 ft. 9 in.; draft aft, 4 ft. 6 in., and is a twin screw job with two 40 b.h.p. Bolinder direct reversible heavy oil engines. A winch driven by a 6/7 b.h.p. Bolinder "Beta" with a lifting capacity of 10 cwts. is fitted at the forward end of the hatchway, in addition to mast and derrick and usual hand windlass.

The vessel made a very fine passage from Faversham to Cowes in just over twenty-four hours, and on arrival proceeded to the measured course, to undergo speed trials, which were very successful, and the speed guaranteed by the builders was obtained to the satisfaction of all concerned.

Interior of Warehouse Q, with Bales of Wool stacked ready for delivery, King George Dock, Hull.

# New Mersey River Wall.

## *Scheme submitted to Liverpool City Council.*

Liverpool Corporation has under consideration a proposal to construct a river wall and embankment along the River Mersey at the point known as Otterspool.

The line of the future river wall between the Herculaneum Dock and Garston Docks was agreed to at a conference held on the 1st June, 1926, at which conference the line, known as the "Mostyn Field" line, was approved. The plan was signed by the accredited representatives of the Mersey Docks and Harbour Board, the L.M. & S. Railway Company, the Manchester Ship Canal Co., the Liverpool Corporation and the Acting Conservator of the Mersey. This agreed line in front of the Otterspool Estate will have the effect of reclaiming, from the foreshore, an area of between 30 and 40 acres or approximately an average width of 160 yards.

The permanent river wall for a distance of 450 yards will require to be about 25 ft. high, which the City Engineer estimates would cost about £60 per yard run. The depth of water at high tide on the line of the retaining wall would be about 18 ft.

As an alternative to this permanent wall, states the joint report of the Liverpool Town Clerk and City Engineer, a temporary embankment 450 yards in length might be constructed of tipped stone, the slope on the river side to be of pitched stone in cement. The estimated cost of this length is approximately £13,500.

With regard to the temporary embankment the effect would be that a width of 50 ft. at least would be temporarily lost to the promenade along the whole frontage, in addition to which a permanent wall would ultimately also be desirable. The embankment would be finished with a cement grouted face to render it impervious and to prevent erosion by the tide, and would remain in this position until further development of the foreshore took place in accordance with the "Mostyn Field" line.

The length of the temporary embankments at either end of the above would be about 750 yards, the cost of which the City Engineer estimates at about £9,000; this estimate is for facing work only and does not include the cost of tipping.

The foreshore largely consists of mud and, subject to the approval of the Committee, the City Engineer proposes to have trial holes made to ascertain the level of the rock and nature of the foundations.

Until these have been sunk the exact type of construction in connection with the foundations of the retaining wall or embankment is uncertain, the estimates mentioned should, therefore, be regarded as being only approximate.

Should the Committee favour the temporary types of construction for the embankment (between the points "Y" and "Z"), the plan would, of course, have to be submitted to the Mersey Docks and Harbour Board for their approval. It is anticipated that the considerable area of low-lying ground within the embankment would be available for the deposit of house refuse (or other type of filling material), such filling, of course, being carried out in accordance with the suggestions made by the Ministry of Health regarding the tipping of such material.

The official permit received from the Acting Conservator of the Mersey provides, inter alia, the embankment to be constructed of hard material excavated from the Mersey Tunnel or similar hard material, and faced with pitching and covered with cement to bind the whole together; instead of embankments the Corporation may construct retaining walls; no material to be deposited within the reclaimed area until the western embankment and the north and south temporary embankments have been completed. The embankments to be completed within a period of five years from commencement, and thereafter to be properly maintained. The Corporation to indemnify the Ministry of Transport and the Dock Board against any actions, etc. The Ministry of Transport and the Dock Board jurisdiction over the foreshore rights and access to the river not to be altered by these conditions.

As a result of the damage by the recent gale to the old dock on the south side of the Otterspool Estate, the City Engineer reports that before this dock can be filled up it will be necessary to expend a sum of not less than £1,000 in making good the damage, and until these repairs are carried out he is unable to take steps to fill up the dock, which the Finance Committee authorised, so as to avoid the danger to persons.

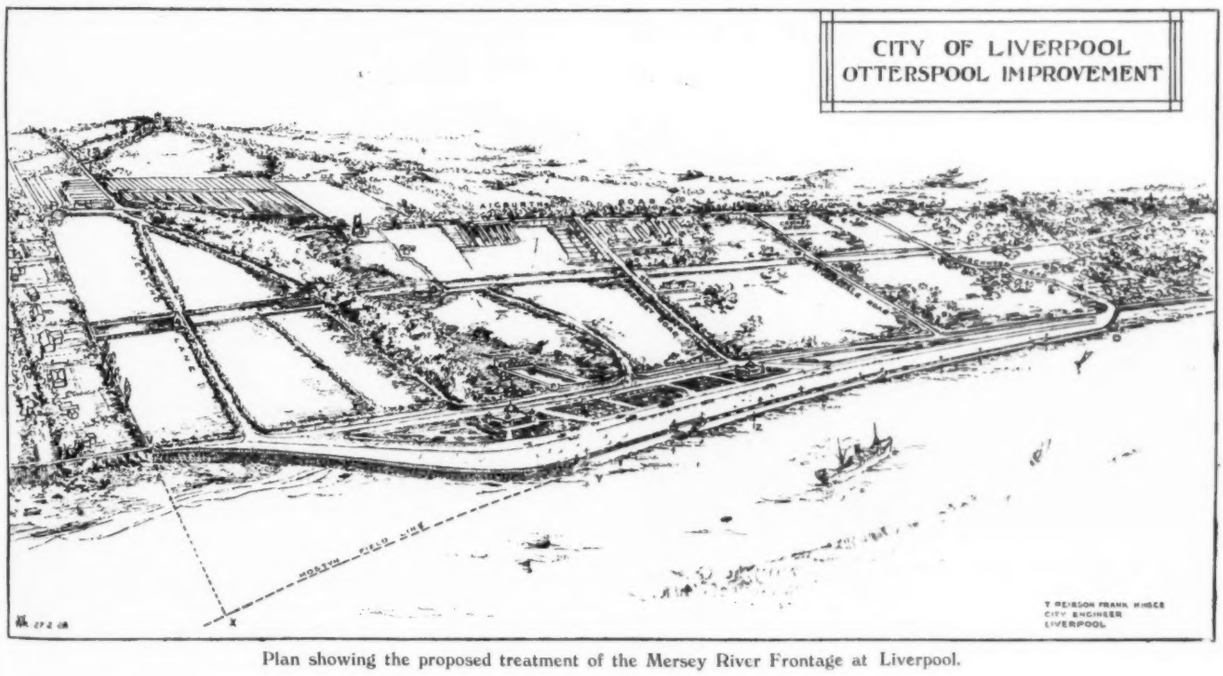
The Town Clerk states for the information of the Committee that the Mersey Tunnel Joint Committee will shortly be entering into a contract for the construction of the complete tunnel under the River Mersey, when a considerable quantity of spoil will be available for use in connection with the construction of the embankment at Otterspool, and in the event of the Corporation desiring to utilise any of this material it will be necessary to make arrangements with the Mersey Tunnel Joint Committee for its disposal at Otterspool.

In a further report to the City Council the City Engineer, Mr. T. P. E. Franks states:—The length of the proposed extension is about 900 yards, and the estimated cost of this work would amount to approximately £59,400. As an alternative to the permanent wall, a temporary embankment about 900 yards in length might be constructed of tipped stone, the slope on the river side to be of pitched stone grouted with cement. The estimated cost of this length would be approximately £25,700. A temporary embankment at the south end of the above would be about 80 yards long. This work is estimated to cost £968.

While it has been assumed that similar conditions would be met with on the extension, the City Engineer suggests that the trial holes be extended along the proposed line to establish data regarding foundations.

Should the Committee decide to construct this extension, it will provide a further area to be raised on lines similar to those suggested in the earlier report. This extension will have the effect of reclaiming a further 20 acres from the foreshore, or approximately a total of 50 acres if the scheme as contained in both reports be adopted. In view of the material additional length of wall which could now be built, amounting, together with that referred to in the former report, to a total length of over ¾ mile, the Engineer suggests for the consideration of the Committee that it might be preferable to proceed with the construction of a concrete wall where the work adjoins the "Mostyn Field" line, rather than the construction of an embankment which was referred to in the first report as an alternative on account of the relatively short length of wall which could then be constructed along the "Mostyn Field" line.

In view of the conditions laid down by the Dock Board, it might be advantageous if the South Return embankment,




Plan showing the proposed treatment of the Mersey River Frontage at Liverpool.

shown on the plan which accompanied the former Report, were also constructed. By this means the filling up of the land behind the new north embankment and the northern portion of the wall could be proceeded with at an earlier date than would otherwise be possible, and this embankment would provide a desirable means of access to the river wall during the time of its construction.

The total estimated cost of a temporary embankment at the north-west end of the work, a concrete wall along the "Mostyn Field" line, a temporary embankment to connect the southern end of the wall to the river bank, and the south return embankment near Mersey Road, is estimated at £99,400. The amount included in this total for the construction of the temporary embankments only covers the cost of hand pitching and cement grouting the faces of the same, and does not include the cost of tipping in embankments. It would be necessary before the work could be commenced to submit the proposals to the Mersey Docks and Harbour Board.

Concerning the proposals, the Town Clerk and the City Engineer submit a joint memorandum, which states that the geographical position of Liverpool and the suitability of the Mersey estuary for the construction of docks have had a great bearing on Liverpool's growth and extension. Of the city's 8½ miles of river frontage, 6 miles are at present used for docks, 1 further mile is reserved for similar purposes, leaving only 1½ miles of river front available for alternative development.

This length of river front is eminently suitable for the development of a riverside esplanade. Inland from this frontage lies one of the city's best residential districts, which includes large areas of land reserved for the use of the public, and it does not require much imagination to picture this river frontage, when completed, crowded with citizens enjoying the facilities to which the site lends itself, viz., a promenade, tennis courts, bowling greens, swimming and boating pools, and other pastimes associated therewith.

The scheme has been communicated to members of the Liverpool City Council with a recommendation for the purchase of certain necessary land.

## Launch of the "Oltenia."

### *Oil Tanker for Rumania.*

The s.s. tank steamer "Oltenia," built to the order of Streaua Romona Societate Anonima Pentru Industria Petroleuleui Bucharest, by Sir W. G. Armstrong Whitworth and Company, Limited, was successfully launched from their Walker shipyard on March 6th.

The launching ceremony was gracefully performed by Lady Stern.

The principal dimensions of the vessel are:—Length overall, 436 ft.; length between perpendiculars, 423 ft.; breadth, moulded, 55 ft.; depth, moulded to upper deck, 32 ft. 8½ in.

The vessel is designed to carry 8,925 tons on a draft of 25 ft. 6 in., and is of the two-deck type, with poop, bridge and forecastle. She is built to Lloyd's highest class on the Isherwood-Bracketless system, to comply with the Suez Canal Regulations, and the Factory Act and Board of Trade requirements.

There are 18 separate oil cargo compartments, 9 port and 9 starboard. Five 'tween deck tanks are arranged on each side of the ship and a double bottom is fitted under the engine and boilers.

One cargo pump room extending from side to side of the vessel, fitted with two horizontal duplex pumps, will be arranged between Nos. 6 and 7 main oil tanks. A double line system of oil piping is fitted throughout the main compartments. The cellular double bottom under engine and boilers will form two separate water ballast or feed water tanks.

The accommodation for the captain and officers will be in deck houses on the bridge and upper bridge decks; the engineers' rooms will be in a deck house on the poop deck, the seamen in the forecastle and the firemen and petty officers in the poop.

Three double-cylinder horizontal-type winches, a steam windlass, also a steam steering gear are fitted. A ballast pump and oil fuel transfer pump are fitted in the pump room on top of deep tank. The vessel is electrically lighted throughout and is fitted with wireless installation.

The propelling machinery will consist of inverted direct-acting quadruple expansion engine having cylinders 25½ in., 36½ in., 52½ in., 75 in. and 48 in. stroke. There will be three single-ended boilers of the multitubular type 14 ft. 9 in. diameter by 11 ft. 9 in. long to work at a pressure of 220 lbs. under forced draft; also a donkey boiler. The boilers are arranged for oil fuel burning.

The Harbour at Port Kunda, Esthonia, situated on the Gulf of Finland. Anchorage in the roadstead is available in 25-ft. of water. Vessels may moor at a pier 660-ft. in length, and three electric cranes are available. Imports are: Coal and Fireproof Bricks. Exports: Cement and Timber. Mr. Friedrich Blumenfeld is Harbour Master.

## The Port of New Orleans.

### *Inspection of Handling Operations.*

A large group of mid-West editors were guests of the New Orleans Dock Board, February 27th, for an inspection of port operations from the decks of the harbour boat "Alexandria." The party, headed by Mr. Harry Denman, president of the Missouri Press Association, were specially interested in the facilities for handling barge-line traffic, and had the good fortune of witnessing vessels of the Mississippi-Warrior service engaged in a diversity of loading and discharging operations in several parts of the harbour. Considerable surprise was expressed at the fact that these barges loaded and discharged at so many private industrial plants, and a great deal of interest was taken in observing the variety of freight that was provided at the different plants and at the public wharves.

In addition to the more familiar operations of handling cotton, sugar, sisal, burlap, and other package freight in and out of the barges, the visitors saw a number of large steel barges discharging grain from the mid-West through the Marine Leg into the public grain elevator, and, at the Public Bulk Commodity Handling Plant, saw an ocean steamship of the Aluminium Line discharging aluminium ore through the Dock Board's shore machinery direct into the holds of the up-river barges which deliver the ore at East St. Louis. These are two operations which are not carried on in any other port of the United States, and the facilities, installed for accommodating barge-line requirements, serve a variety of purposes in expediting the movement of freight and shipping.

Among other port activities which made impression on these visitors was a steamship discharging rolls of Canadian newsprint at the Public Cotton Warehouse—paper which is usually shipped by rail or barge into the very territory from which these editors had come, and paper on which their own journals may chance to be printed within a few days. The quantity of shipping in the port surprised these editors, notably the number of banana vessels, of which several were discharging through the mechanical conveyors at three different points in the harbour. (Over 20,000,000 bunches of bananas are imported at New Orleans each year.)

## Port Dues in Yugoslavia.

### *Prevailing Rates of Exchange.*

The Department of Overseas Trade has received from the Commercial Secretary at Belgrade the following list of official rates of exchange for the payment of port dues in Yugoslavia during March, 1928, which appeared in the "Official Gazette" of 25th February:—

| | Dinars. |
|---|---|
| 1 Gold napoleon ... ... ... ... | 218.70 |
| 1 Pound sterling ... ... ... ... | 277.20 |
| 1 American dollar ... ... ... ... | 56.85 |
| 1 Canadian dollar ... ... ... ... | 56.55 |
| 1 German mark, gold ... ... ... | 13.57 |
| 1 Polish zloty ... ... ... ... | 6.37 |
| 1 Belga ... ... ... ... ... | 7.92 |
| 100 French francs ... ... ... ... | 223.50 |
| 100 Italian lira ... ... ... ... ... | 301.00 |
| 100 Dutch florins ... ... ... ... | 2,290.00 |
| 100 Roumanian leis ... ... ... ... | 35.00 |
| 100 Danish crowns ... ... ... ... | 1,522.00 |
| 100 Swedish crowns ... ... ... ... | 1,525.00 |
| 100 Norwegian crowns ... ... ... | 1,513.00 |
| 100 Spanish pesetas ... ... ... ... | 962.00 |
| 100 Greek drachmas ... ... ... ... | 75.30 |

Personal enquiries regarding all shipping and transport matters should be made at the City Office of the Department (Shipping and Transport Section), 73, Basinghall Street, London, E.C.2.

# The Chain as a Medium of Power Transmission.*

By R. COULSON, Assoc.R.C.Sc.I., M.S.A.E.

The transmission of power from one place or situation to another may be accomplished by any one of four general methods, or occasionally a combination of methods may be used. These four methods are the following:—

(1) Mechanical (3) Hydraulic
(2) Electrical (4) Pneumatic

At the present time the third and fourth methods are not employed to any great extent, and the choice between the first and second is largely dependent upon the distance through which the power has to be transmitted, mechanical methods being suitable for relatively short distances. Since it is the author's intention to deal with such cases only, he does not refer further to the second method.

Mechanical methods themselves fall under four general heads, that is to say, the transmission may be by means of shafting, belts or ropes, spur gearing, and last, but not least, chains. The first may be used to transmit power through greater distances than the other three, but alterations in speed cannot be obtained by this means. If a ratio other than unity required, recourse must be had to one of the other three methods mentioned. If, again, a positive transmission is essential, belts and ropes are eliminated, thereby leaving the choice between spur gearing and chain. How does the situation lie between these two? Spur gearing is suitable for short centres only unless long trains, with attendant trouble in mounting, are used. It is also, due to its rigidity, unsuitable for many applications. It may be well at this juncture to tabulate the advantages of chain transmission, the major of which are the following:—

**Efficiency.**—With either of the two principal types of chain, namely, roller or inverted tooth, the losses in a well-designed drive do not exceed two per cent. of the power transmitted. They may on occasions be considerably less than this. Moreover, this efficiency is sustained practically throughout the life of the drive, due to the property which chains possess of adapting themselves to the wheel teeth even after extensions in pitch have taken place due to wear in the joints.

**Compactness.**—Compared with a belt or a rope drive, a chain drive transmitting the same power can be installed in a very much smaller space. It is common to see valuable floor space taken up by motors and a shop virtually partitioned off by belt drives where this type of transmission is used. With chain-drive, on the other hand, motors can be carried on girders in close proximity to any shafting to be driven, resulting in no waste of floor space, no obstruction of gangways, and a minimum of interference with lighting.

**Positiveness.**—With chain transmission the speed ratio between the driving and the driven shafts is constant, the actual revolutions being, of course, inversely, as the numbers of teeth in the two wheels. Irregularities in the load cannot cause slip. This is a very valuable feature in certain applications, such as drives for machine tools and textile machinery.

**Elasticity.**—Although slipping is impossible there is always a slight amount of elasticity present in a chain drive (at all events, in those which are not inclined too steeply to the horizontal and have a reasonable centre distance), due to the catenary effect and the oil film in the joints. This virtue frequently enables chains to be employed where other methods of transmission having too great a rigidity have failed.

**Quietness.**—The noise emitted by a well-proportioned chain drive, efficiently lubricated, is practically negligible, a point in which this form of drive is superior to spur gearing.

Amongst the minor advantages the following may be stated:—

## PROPORTION AND LUBRICATION.

There is no appreciable disturbance of the air in the neighbourhood even of drives which are run uncased, and none at all where cases are fitted.

Static electrical effects such as occur with some belts are, of course, entirely absent.

When a drive is cased in and lubricated it is independent of the surrounding atmospheric conditions.

Chains are primarily tension members (although it may here be remarked that they have on occasions been constructed to act in compression). The stresses encountered are tensile as in the side plates of roller chains, combined tensile and bending as in inverted tooth arched links, shearing on the rivets of both types, bearing between rivets and bushes.

It will perhaps be well at this stage to describe the two types of chain used as media of power transmission. These two types are the roller chain and the inverted tooth (sometimes called noiseless or silent). The first-named is made in two series of pitches, called respectively standard or medium pitch, and long pitch, the latter being developed from the former by the substitution of plates having twice the standard pitch. The roller type of chain consists of outer or spindle plates, inner or bush plates, bushes, rollers and rivets. The appellation "rivet" is perhaps a trifle unfortunate; the prime function of the part is to act as the male member of a bearing, the actual riveting is a secondary consideration. "Rivet" is, however, the term generally used, although the part is also called a stud or a spindle.

Dimensionally, a roller chain can be specified completely by quoting the pitch, the width between the inner plates, and the roller diameter. There are in general two widths per pitch, those designated "narrow" being approximately 4-10ths of the pitch between the inner plates, and those designated "wide," which are approximately 6-10ths of the pitch between the inner plates.

The "wide" series is to be preferred for general use. Where, as is usually the case, plates having the same strength and weight are used for both, an increase in bearing area is obtained in the wide chain without a corresponding increase in the weight per foot. The ratio of the roller diameter to the pitch varies from 9-16ths to $\frac{5}{8}$rds, a good proportion being $\frac{5}{8}$ths, since this allows a reasonable bearing area to be obtained in combination with a substantial wheel tooth.

## ASSEMBLING OF PARTS.

The rivets, bushes and rollers are assembled concentrically, and the actual diameters are so arranged that the spindles and the bushes are force fits in their respective plates. This, in general, has been found sufficient to retain the inner plates in position (the riveting of the spindles holds the outer plates), but of recent years the constantly increasing duty imposed on motor-cycle chains has made felt the need for positively locking the inner plates to the bushes. At very high speeds, surging and a possible slight twisting action on the chain cause the inner plates to move outwards along the bushes until they come into contact with the outer plates; friction between the surfaces then prevents easy articulation, which again results in fractured rollers, due to improper engagement with the wheels. Certain methods have been adopted to overcome this; that used by the author's firm consists in spinning over the ends of the bushes into countersunk recesses in the inner plates after assembly of the roller blocks.

The bearing at each joint of a roller chain is formed between the case-hardened surfaces of the rivet or spindle and the bore of the bush; it therefore extends across the chain for the whole width of the bush. The rollers take their bearings on the outsides of the bushes, and are free to revolve thereon; they are necessary in order to reduce friction and prevent wear during the engagement and disengagement of the chain links with the wheels.

Since the tooth forms for roller chain wheels consist of curved surfaces, it follows that the contact between the rollers and the teeth is, theoretically, a line only, although in practice this, of course, resolves itself into an area. With the inverted tooth chain, on the other hand, there is, both theoretically and practically, a definite contact area between the link faces and the wheel teeth.

The basis of the inverted tooth chain is the link plate, which is blanked in a press from steel strip of the requisite quality; it is also pierced suitably for the bush or other type of joint used, and is generally ground on the engagement faces.

With the exception of a particular design of link produced by one maker, engagement of the links with the wheel teeth is confined to the two outer faces, which usually make an angle of 60 degrees with one another, though other values, as large as 80 degrees, and as small as 52 degrees, have been employed. The use of such extreme angles, however, imposes limitations on the number of wheel teeth permissible; the former requires a low maximum, the latter a high minimum. A compromise angle of 75 degrees has been used by the author's firm very successfully for certain applications, notably automobile camshaft and gear-box drives, the reason for its adoption being the possibility of fitting a larger rivet than with the 60 degree angle, and hence obtaining a narrower chain for a given bearing area.

The chief difference in the inverted tooth type of chain as produced by the various makers at the present day centres around the form of joint employed. This may consist of circular rivets or studs working in circular bushes, or segmental bushes, carried in the individual link plates or blocks. Alternatively, they may work against segmental "liners" extending across the full width of the chain, which take their bearing in the link plates of one combination, and have clearance holes provided in the link plates of the other combination.

A rival form of joint is the Rocker type, which consists of two pins of appropriate section, the one termed the "seat pin," the other the "rocker pin," both of which extend right across the chain. Rolling friction is substituted for sliding friction with this form of joint.

Roller chains are maintained in position on the wheels, laterally, by reason of the fact that the teeth pass between the inner plates. With the inverted tooth chain, however, it is necessary to fit guide plates or else to use flanged wheels. The last mentioned method is no longer used in this country, but is still the practice of one large maker in America; for a given link face

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contact area the chain is lighter than one fitted with guide plates, but other difficulties are introduced, notably that the chain must be rivetted up endless, either in position or before assembling upon the wheels.

Guide plates may be fitted either at the sides, when the chains are known as "O.G.P.," or in a single row at the centre, when they are known as "C.G.P." chains. Where, as is the case with the chains produced by the author's firm, the guide plates are bushed, and therefore contribute a portion of the bearing area, there is not much to choose between these two methods of guiding, but it may be remarked that there is a waste of wheel material where centre guide plates are used.

So much for the actual chains themselves. To descend into the realms of mechanics, it may be recalled that power is defined as the rate of doing work, and that work is force multiplied by distance. A chain drive furnishes a very literal example of this. The force is the effective tension in the chain, and if it be multiplied by the distance the chain travels per minute the product is the rate at which work is done; it can be converted to horse-power by dividing by 33,000. Conversely, when the horse-power and chain speed are known the effective driving tension can be calculated. It will be observed that the author refers to the effective tension in the chain; there is, additionally, a non-effective tension induced by its own inertia, which is manifested in two ways. There is what may be termed a "static" effect, due to catenary action, which varies with the weight of chain per foot, the amount of free length, and the sag. There is also a dynamic effect due to the action of centrifugal force, which produces a uniform tension throughout the length of the chain, the actual value depending upon the weight per foot and the square of the linear chain speed.

## CHAIN TENSIONS.

Certain formulæ relating to chain tensions which may be of interest are given in Appendix I. From what has gone before it will be evident that the allowable tension in a chain and the maximum speed at which it may be run are pertinent subjects for discussion. The former immediately resolves itself into a question of bearing pressure since with the designs in use at the present day, if this is kept within limits which will ensure a reasonable life, a large factor of safety against breakage is automatically obtained. Indeed, the figures used must often seem absurdly high to, for instance, a structural engineer. The actual pressure allowable depends largely upon the rubbing speed between the surfaces composing the joint, normal maximum is 2,000 lb, per square inch for roller chains, and 1,500 lb. per square inch for inverted tooth chains, the projected bearing area being considered in each case. For very slow speeds higher pressures may be used, but with both types of chain there comes a point where diminution in speed is not sufficient to compensate for an increase in specific pressure. The values mentioned may appear to be on the high side, though it should be borne in mind that, due to the relatively small diameters of the parts involved, the rubbing speeds are low and the motion is not continuous but intermittent.

Turning now to a consideration of the second component, namely chain speed, this is a matter which must at all times be viewed in conjunction with the pitch of the chain under consideration and the number of teeth in the pinion or smallest wheel in the drive.

Experience teaches that shaft speed is the important factor. A high linear speed obtained by the use of a large number of teeth and a reasonable shaft revolution speed may for instance be quite satisfactory, whereas the same speed resulting from a small pinion and high shaft revolutions may be unsatisfactory. In the latter case the rotational speed in the chain joints (which is the same as that of the shaft) is higher, and the impact between the rollers, or link faces, and the wheel teeth is more severe.

## PITCH AND SHAFT SPEED.

Appendix II shows the relation between pitch and maximum shaft speed for both roller and inverted tooth chains, the figures given being representative of modern practice in industrial applications. From these it will be apparent that for any given shaft speed a limit is set to the pitch that can normally be used and, consequently, the transmission of high powers at high pinion speeds is difficult with chain owing to the excessive widths necessary to provide sufficient bearing area in the smaller pitches. A maximum, therefore, is to use medium or low speed motors (where they are the source of power) when the transmission of large horse-powers is in question.

Certain limitations in the numbers of teeth in wheels, both minimum and maximum, are imposed by good practice; for instance, it has been found inadvisable to use less than 19 teeth in pinions for drives running at normal speeds, whilst at the other end of the scale 140 teeth, or thereabouts, is an economic limit, owing to the fact that the possible chain life diminishes with an increase in the number beyond this, since a given percentage of pitch extension causes a chain to ride higher on the teeth of a large wheel than on a small one.

With drives having any considerable ratio of reduction (or increase), the linear chain speed will automatically be kept within reasonable limits since large pinions cannot then be used. In drives of low ratio it is, however, desirable to employ such numbers of teeth that the sum on both pinion and wheel will not be less than 50.

Since for a given shaft speed and power to be transmitted the load tension in a chain varies inversely as the linear speed, and the centrifugal tension varies directly as the square of the linear speed, it follows that by increasing the chain speed successively a point will be reached where the sum of the two tensions will be a minimum. After passing this point the centrifugal tension will predominate and the total will rise rapidly. The point of least tension can be found by differentiating the expression for the sum of the two and equating to zero, or:—

Chain speed for least combined tension =

$$1240 \sqrt[3]{\frac{\text{Horse-power}}{\text{weight per ft.}}}$$

As a matter of practice it has been found better not to exceed 27 or 29 teeth for pinions running at the speeds mentioned in Appendix II.

A question which may naturally be asked at this stage is when should a chain of the roller type be employed in preference to the inverted tooth, and vice versa?

The answer is that where silence is essential the latter type should be used; where noise is relatively unimportant, but a robust drive which will function satisfactorily under adverse conditions is required, the former should be specified. The power to be transmitted will, however, often settle the question in favour of the inverted tooth. Where price is an outstanding consideration the roller type, subject to the power being within the capacity of a triple, or at most two duplex chains running side by side, will almost invariably secure the verdict.

Comparing the two types of chain on a width for width, or weight for weight, basis the roller will be found to score heavily so far as bearing area is concerned; this, combined with greater accuracy in manufacture and improved tooth forms for the wheels, is undoubtedly responsible for its increasing popularity at the present time.

## HIGH-SPEED POWER TRANSMISSION.

There is one field where roller chains of the duplex type are steadily supplanting the inverted tooth, namely, on automobile camshaft and auxiliary drives. Nor is their use confined to slow or medium speed engines; they are to be found in conjunction with an automatic tensioner on which is admittedly the highest speed engine in regular production in this country to-day—an engine capable, normally, of 6,000 r.p.m.

Another example of the roller chain adding to its laurels as a medium of high-speed power transmission occurred in connection with the 1,000 h.p. "Sunbeam" racing car, which last year set up a new world's record for car speed by covering a measured distance at the rate of 203 m.p.h. on Daytona Beach, U.S.A. The designers of the record breaker eschewed a live axle construction and pinned their faith to roller chains for the transmission of the engine power from a jackshaft to the rear wheels. The author was entrusted with the somewhat anxious task of prescribing for the exceptional conditions, and after considerable investigation decided upon a pitch of 1½-in., an inside width of ⅞-in., and a roller diameter of .85-in.

The chains used were standard production so far as proportions and material were concerned, but in view of the special circumstances attending their use, additional precautions in respect of examination and test of both the components and the completed chains were imposed. The chain speed during the run was 6,100 ft. per minute, and the centrifugal force tension would be approximately half the driving tension; the two together produced a bearing pressure of 5,200 lb. per square inch of projected area.

Whilst dealing with the subject of chain for the final transmission on motor vehicles, mention may be made of possible developments in connection with six-wheelers. The usual practice at the present time is to fit such vehicles with two live axles; this is not only expensive, but heavy, and there is no reason why, at least in the case of buses and lorries intended for use on roads only, the second live axle should not be dispensed with, and the driving wheels on each side be coupled by means of chains. The conditions for such drives, due to the 1:1 ratio rendering possible the use of reasonable numbers of teeth in both wheels, are considerably better than would be the case if a reduction of, say, 1.75 to 1 had to be accomplished on the chain.

Vehicles intended for cross-country work fall in a different category; chains are not suitable for dealing with the large axle displacements then encountered.

## USE IN DIESELS.

Before leaving the subject of roller chain applications, mention may be made of their use for driving the camshafts of large Diesel engines, also for the driving of train-lighting dynamos; very successful results have been obtained with both of these.

The chain coupling is an example of the use of the Duplex roller chain although in this instance power is not transmitted by it in the ordinary manner, rather does it provide an easy

method of assembling quickly a number of pins capable of transmitting torque by their shearing resistance. The complete coupling consists of two similarly cut wheels mounted on the ends of the shafts to be coupled, their distance apart being such that the Duplex chain can be wrapped around the two. Ease of disconnection is a prominent feature of these couplings.

In the foregoing, a general idea has been given of the scope of the two types of chain used for power transmission purposes; it may now be well to mention a few factors which contribute to a successful drive.

Centre distance and disposition are two matters in which the user can co-operate with the chain maker if acquainted beforehand with the desirable conditions. Concerning the former, forty to fifty times the pitch of the chain to be used is a suitable figure if there are no restrictions present; the chain length is then such that it does not repeat too frequently, neither is the free length so long that unnecessary loads are imposed on shafting or bearings. The maximum centre distance advisable varies with the ratio and the size of the wheels; a rough rule which applies to normal drives, is the following:—

Maximum centres in inches—

$$= \frac{1{,}000}{\sqrt{\text{R.P.M. of Slower Shaft}}}$$

subject to the proviso that the revolutions per minute of either shaft are not less than 35 where a roller chain is to be used, or 70 for the inverted tooth type.

A point which should be borne in mind is that a chain will not join up without slack except at specified centre distances, which are approximately the pitch of the chain apart, or half the pitch apart if a cranked link is used; the latter, however, is not a desirable procedure and is, moreover, impracticable in the case of compound roller chains. Where it is essential to use a centre distance which will not allow the chain to join up without slack a jockey may be used to get over the difficulty and, if adjustably mounted, it may be used to compensate for any elongation that may develop.

Where a jockey is not fitted provision for adjustment of the centre distance should be made in order that the full life of the chain may be available. The range of adjustment provided should be from half a pitch in the negative direction to one pitch in the positive direction. The negative adjustment is helpful when fitting a chain.

Dispositions in which the slack or non-driving free length of a chain will be inclined at a greater angle than 60 degrees to the horizontal should be avoided if possible. When arranging electric motor drives to lineshafts a convenient angle for the inclination of the centre line is 45 degrees, with the motor in the upper position. This allows a chain case of the oil-bath type to be used, whereas a similar inclination with the motor below, or a horizontal disposition, is not so satisfactory from the point of view of obtaining efficient lubrication of the chain and at the same time preventing leakage of oil.

With pump lubrication, which is advisable for high speed drives and those on which multiple chains are used, the question of disposition is not so important. The pump delivers oil to the working faces, whence it drains down to a small sump formed at the lowest part of the case. A valveless rotary type of pump is generally fitted, driven at a speed of 200/300 r.p.m. by means of a light cotton belt from the slower shaft.

A medium body pure mineral oil should be used for the lubrication of drives running in cases, whilst for those required to run exposed, or for a length of time without attention, the use of graphite in a suitable form, such as "Oildag," is recommended.

## INSTALLATION AND MAINTENANCE.

A few remarks on the installation and maintenance of chain drives will probably be of especial interest, though it can be generally stated that no exceptional skill is required. The point to which it is most necessary to draw attention is the need for accurate alignment; this can be tested either by a straight edge laid across the faces of the two wheels or else by a piece of cord. Mal-alignment causes wear on the inner faces of inverted tooth chain guide plates and roller chain inner plates.

Where the source of power is an electric motor the end play of the armature spindle should be limited to 1/64th of an inch per foot of centre distance, with a maximum of $\frac{1}{8}$-th of an inch.

Apart from the above, ordinary commonsense precautions only are necessary, such as mounting the drives close to rigid bearings, securing parallelism of shafts, etc.

The amount of tension allowable is always a vexed question for those installing chain drives for the first time, and a reference to maintenance booklets does not usually help matters very much since the instruction generally given is that the chain should be adjusted to the "correct" degree of tension. As a guide to this it is desirable, therefore, to comment as follows:—Do not run with too tight a chain. For a new drive with a steady load, it should be possible to depress the mid-point of the free length from the straight line the following amounts:—1/16-th of the centre distance where the slack side is horizontal or is inclined at not more than 45 degrees; 1/20-th of the centre distance where the slack side is inclined between 45 and 60 degrees to the horizontal; 1/30-th of the centre distance where the slack side is inclined between 60 and 70 degrees to the horizontal. Vertical drives, and drives with an impulsive or irregular load, should be run with practically no slack. A worn chain should be adjusted to suit the running condition; it should be allowed more slack when stationary than a new chain.

## CHAIN REDUCTION BOX.

There is another special application, which provides a very neat and compact solution where large ratio reductions are required, namely, the chain reduction box. These reduction boxes are self-contained and where, as is usually the case, an electric motor is the source of power the two can be assembled on a common bed-plate, thus ensuring rigidity of mounting. The speed reduction in the boxes is accomplished by using one, two, three, or four drives, depending upon the ratio required. The wheels and pinions are mounted on short and stiff shafts carried in ball or roller bearings; the casing is of cast-iron and forms an oil bath, so that efficient lubrication is ensured. The shafts are arranged in two lines only, so that in the case of the double and quadruple reduction boxes the output and input shafts are in line; in the single and triple boxes they are displaced, the input being in one line, the output in the other. Due to the rigid mounting of the shafts and the thorough lubrication the overall efficiency of these boxes is very high; and here again the slight flexibility of the chain is a distinct asset when fluctuating loads have to be dealt with. Ratios up to 6 to 1 are executed as a single reduction from 6 to 1 up to 16 to 1 as a double reduction, from 16 to 1 up to 60 to 1 as a triple reduction, and from 60 to 1 upwards as a quadruple reduction box.

As an example of one of these may be quoted a quadruple box used in the drive to a coal conveyor at a Midland Gas Works; the power transmitted is 25 h.p., and the reduction is 135 to 1, from 675 r.p.m. to 5 r.p.m.

Needless to say, the design of these boxes is a specialist's work and it is unnecessary here to go into any particulars regarding speeds and bearing pressures.

### Appendix I.

Chain Drive Formulæ:—$P$ = Pitch of chain in inches; $W$ = Weight of chain in lb. per foot; $N$ = No. of teeth in wheel.

| | |
|---|---|
| Chain Speed ft. per minute. | $\frac{NP}{12} \times$ R.P.M. of Wheel |
| Tension in Chain due to Drive. lb. | $33{,}000 \times \frac{\text{H.P. transmitted}}{\text{Chain speed}}$ |
| Tension in Chain due to Centrifugal Force lb. | $8.6\ W \times \left(\frac{\text{Chain speed}}{1{,}000}\right)^2$ |
| Tension in Chain due to Catenary Pull lb. for all drives where the inclination of the "slack" side of the chain to the horizontal does not exceed 80 degrees. | Average value $2.5\ W$ + centre distance of wheels in feet. For very steady drives where a large amount of sag is permissible this value may be reduced to $1.5\ W \times$ centre distance; on the other hand, for impulsive drives, where it is essential that the amount of sag is kept small, the value may be as much as $5\ W \times$ centre distance. |
| Total Tension in Chain lb. | The sum of the tensions due to drive, centrifugal force, and catenary pull. |
| Pressure on Rivets lb. per sq. inch. | Total tension divided by rivet bearing area in sq. inches. |
| Factor of Safety | Breaking load of chain divided by total tension in chain. |

### Appendix II.

(*a*) Maximum Shaft Speeds Recommended.

| Pitch of Chain. Inches. | Maximum Shaft R.P.M. I.T. Type. | Roller Type. |
|---|---|---|
| $\frac{3}{8}$ ... | 2,600 ... | 3,500 |
| $\frac{1}{2}$ ... | 2,000 ... | 2,400 |
| $\frac{5}{8}$ ... | 1,500 ... | 1,775 |
| $\frac{3}{4}$ ... | 1,200 ... | 1,400 |
| 1 ... | 950 ... | 950 |
| $1\frac{1}{4}$ ... | 700 ... | 700 |
| $1\frac{1}{2}$ ... | 550 ... | 550 |
| $1\frac{3}{4}$ ... | 475 ... | 450 |
| 2 ... | 400 ... | 375 |
| $2\frac{1}{2}$ ... | 325 ... | 275 |
| 3 ... | — ... | 225 |

(*b*) The above Table is representative of modern practice in industrial applications: for special conditions, such as those under which camshaft and auxiliary drives for automobiles operate, the speeds given may be exceeded considerably.

# Harbour Engineering Notes.

## THE MAGNETIC RECOVERY OF FUEL IN ASH.

Realisation that the cost of coal is not likely to fall very much, if at all, power engineers have devoted some attention to improving the fuel economy of their plants by recovering a proportion, at least, of the coal and coke that is inevitably wasted in the ordinary hand-fired grates. It has been variously estimated that this loss of combustible matter ranges between 5 up to as high as 50 per cent., and it is not therefore surprising that engineers have turned their attention to methods of recovering this unburned fuel. Several machines have been put into use which rely on wet separation, i.e., the coal and coke is separated from the ash and clinker by a fluid, the specific gravity of which can be controlled at will, the ash and clinker sinking, and the coal and coke floating long enough to be skimmed off. Methods based on this principle have been very successful, though objection is sometimes taken to them on the ground that the fuel so recovered is wet. It is primarily this objection that has led to the use of the magnetic separator, and this device has enabled power plants to recover as much as 87 per cent. of the total combustible matter in the ash.

The use of the magnetic separator for this class of work is based on the fact that ashes are attracted within highly concentrated magnetic fields, whereas the magnet has no influence on coal and coke. This difference in the magnetic properties of ash and coal is explained by the circumstance that the ferrous non-magnetic material contained in every kind of coal, though in very fine distribution, is converted during combustion into magnetic iron compounds, which pass into the ash or clinker and make it susceptible to magnetic attraction. Further, it is found that these magnetic iron compounds are concentrated in the ash in inverse proportion to the percentage of ash contained in the fuel.

The separator employed for this purpose follows the standard type of pulley construction used for chemical and other purposes, the separating pulley constituting a pulley at the end of a belt conveyor, over which passes the material to be treated. The magnetic material is held in contact with the belt until it passes out of the magnetic field, when it is dropped into a bin, while the coal and coke is shot straight off the end of the belt.

In the plant adopted for separating coal from ash, one separator pulley is usually sufficient to treat from ½ to 2 tons per hour, the pulley having from one to four magnetic fields. The ashes are fed, as a rule, on to a belt by a shaking screen. The working costs of such a plant are small, the power required for the pulley amounting to 0.8 or 1 kw. per ton of ashes, while the power required for driving such a separating unit, including the shaking screen, is only about 1 h.p.

The slag and clinker so extracted is very suitable for the manufacture of slag bricks, which must be free from coal and coke.

## WELDED REPAIRS TO OCEAN-GOING VESSELS.

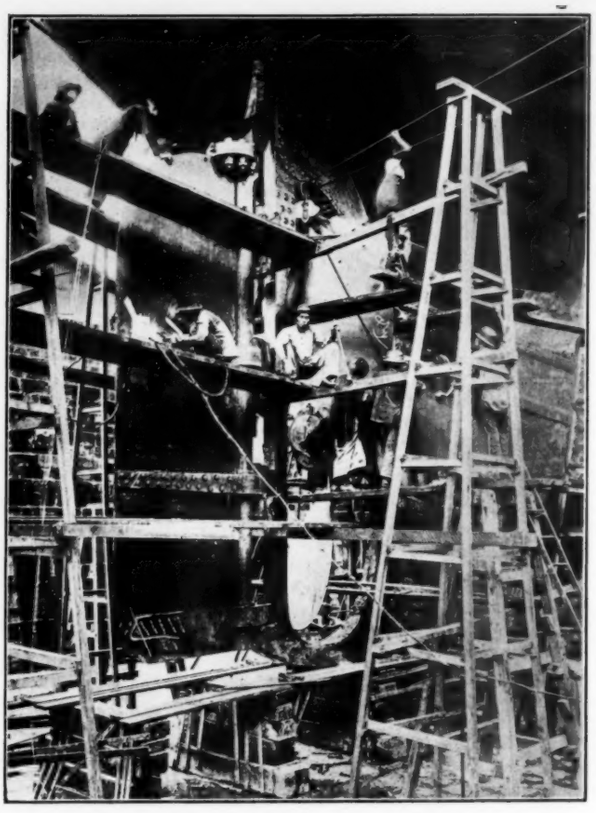
Since the first important repair with electric welding was carried out, that to the sternpost of H.M.S. "Ramillies," considerable work has been proceeding in this direction, and a large number of effective permanent repairs have been carried out. In the case of the vessel mentioned above, it will perhaps be recalled that the fractured cast steel sternpost of the "Ramillies" was repaired in record time, during 1917, a critical period of the war, so that a long period of inactivity in dock was saved when her services were so urgently required with the fleet.

The illustration shows the sternpost and rudder of a large vessel undergoing repair in Singapore Dock. This vessel was in for painting, when attention was drawn to the riveting of the rudder arms to the rudder plate. The greatest portion of these rivets were loose and had to be removed and re-riveted for the vessel to go out on the next tide. As no other means of removing the rivets was available, it was decided to use the electric welding process to cut them out. This was successfully accomplished, the heads being burnt off with a high tension current, and the remainder of the rivets were punched out. The work was carried out successfully and the vessel left dock in time.

Where electric welding has, perhaps, most demonstrated its usefulness is in carrying out repairs at a moment's notice in places where the usual repair facilities are non-existent. An instance of this is afforded by the case of a 12,000-ton liner, which arrived at a small isolated port where it was held up through engine trouble. On examination it was ascertained that the journal of the main engine crosshead had fractured at the neck, necessitating the construction of a new crosshead.

The usual methods for carrying out such work necessitate heavy forging, and this could not be done as no steam hammers were available. The problem was eventually solved by welding two 12 in. by 12 in. by 6 in. steel blocks to a length of 11 in. diameter shafting. The whole was then machined and planed to size, resulting in a first-class piece of work.

In this job the electric welding process was used, and about 1,400 ft. of No. 8 and 200 ft. of No. 10 "Quasi-Arc" mild steel



Sternpost and Rudder of a large Vessel in Singapore Dock undergoing repair by the Electric Welding Process.

electrodes. The work was carried out in 50 hours, without a stop, which turned out to be less than half the time necessary had the usual methods of construction been employed. This speed in repairing turned out to be most important as the vessel had already been delayed by the accident.

## SUPERHEATED STEAM IN EXISTING PLANTS.

That a superheater may be installed in the gas passages in the boiler is a factor of great advantage to the existing power plant. It means that a superheater installation may be made without radical changes in the station, it being merely necessary to instal the superheater and connect it up to the boiler and steam lines.

The capacity of existing steam lines that are overloaded on account of increased demand from the plant, thus involving pressure drop and heat losses, can be increased by superheating, so permitting of better pressure regulation, heavier loads and lower friction and radiation losses. Likewise, the lower steam consumption of prime movers that accompanies superheating is equivalent to increasing the plant capacity. Superheaters cost less initially per unit of heating surface than boiler heating surface, and they cost less to maintain. As they also save fuel it is obviously a wise procedure to examine the possibilities of increasing the output of the plant by installing high efficiency superheaters before additional boilers are erected.

Not uncommonly old boilers must be worked at reduced pressure on the score of safety, so that economy and capacity are adversely affected. By installing superheaters the objections to reduced steam pressures may be counteracted, and the capacity can often be increased simultaneously with economy. Again, as the uses for steam multiply and the transmission distance extends about the works, return drainage, condensation, radiation and friction become the more troublesome.

Most works can operate profitably and safely on superheated steam. It must be borne in mind, however, that the higher the superheat the greater the economy, so that in considering the use of superheaters, the highest practicable degree of superheat consistent with works conditions should be adopted, so that the full advantages of superheated steam may be realised.

## TRANSFORMER OIL DRYERS AND FILTERS.

One very important aspect of the maintenance of electrical machinery is the care devoted to transformers, and increased attention is now being paid to the quality of the oil used in connection with these important factors in any electrical system. The deleterious effect of water on the dielectric strength of insulating oil is now, generally speaking, very much better known than it was a few years ago, though its seriousness is not yet fully appreciated. It has been found that the moisture content of such oils must not exceed 0.001 per cent. in order to obtain a dielectric strength of 22,000 volts across a 1 in. gap between discs 1 in. in diameter

In any transformer operating on varying load there is continual breathing or interchange of air between the outside and the space between the oil and the cover. This usually results

in the absorption of atmospheric moisture by the oil so that it is generally considered advisable to test the oil from the bottom of a transformer about once every three months.

Fine dust reduces the dielectric strength of oil almost as effectively as water, especially if the dust is of a metallic nature. The continual heating of the oil affects the viscosity considerably and results in the production of a thick sediment. This should also be removed in order to preserve the normal flowing properties of the oil and to prevent clogging of the oil channels.

The oil dryers and filters which have been developed for this class of work attain their object by the simple expedient of forcing the oil under pressure through several layers of dry blotting paper in a specially designed filter press. The paper used is a soft white blotting paper, chemically pure and it may be obtained cut to the exact size to fit the press, and with the necessary inlet and outlet holes for the oil.

Any solid matter in the oil is retained in the paper while the water is arrested by capillary attraction. The drying properties of the blotting paper are due to the greater capillary attraction for water than for oil. A striking illustration of the water-retaining properties of blotting paper may be obtained by placing a sheet first in a vessel containing oil and then in one containing water. It will be seen that on placing the oil-saturated paper in water the oil is driven out and its place taken by water. Reversing the process, when water-saturated paper is dipped in oil, no such displacement occurs.

One filtration is generally sufficient to produce a dielectric strength of 28,000 volts., which corresponds to one part of water in 250,000 parts of oil. To attain a greater purity than this is of no advantage, since it is impossible to maintain such a standard when the oil is in use.

Two sizes of filter equipment are generally in use for ordinary industrial purposes, viz., 7 in., 14 chambers, having 7 sq. ft. of filtering surface; and 12 in., 20 chambers, having a filtering surface of 30 sq. ft. Rotary gear pumps or multi-stage centrifugal pumps are used, depending upon the size of the filter and the individual requirements of the case. The entire outfit can be mounted on iron wheels if it is desirable to make it portable.

The essential part of the filter consists of a series of alternate cast iron plates and frames. The blotting paper is placed between them and the whole clamped tightly by means of a large screw and lever at one end. The surface of the plate, except for a $\frac{1}{2}$ in. rim round the edge, is grooved both vertically and horizontally on both sides, forming a pyramidal surface, thus providing channels which communicate with the outlet at the corner. The oil enters at the lower left hand corner of the stationary end of the filter, passes through a series of cored holes in the frames and plates and punched holes in the blotting paper, and enters and fills in parallel the chambers formed by the frames. It then passes through five layers of blotting paper along the grooves of the pyramidal surface to the lower left-hand corner of the plate, and then through a series of small holes to a cored passage way similar to the inlet.

All the plates are very thin and are so connected that the oil circulates in parallel so that great capacity and a large filtering surface are obtained in a small space. It is essential that the pyramidal surface be perfect in every way in order to support so delicate a material as blotting paper against the oil pressure, particularly as paper soaked with oil and water is very weak. The filters are usually constructed to stand a working pressure of 100 lb. per sq. in.

Electric drying ovens specially designed for drying the filter papers are constructed in two sizes, viz., for the 7 in. and 12 in. filters. The oven is divided into four compartments to permit drying the paper by stages, a proceeding which is especially desirable during hot and damp weather. The heating unit consists of a single winding which can be used either for alternating or direct current.

For best results the paper should be dried for at least 24 hours at a temperature not exceeding 85 deg. C., and then saturated with dry oil the instant it is removed from the oven and before it has cooled. It should not come into contact with the hands more than is absolutely necessary, because of the danger of absorbing perspiration. The importance of the drying oven as part of the whole equipment cannot be over-estimated, as the thorough drying of the oil is entirely dependent upon the degree of dryness of the paper.

The temperature at which filtration and drying of the oil may be most successfully carried out ranges between 25 deg. and 75 deg. C., and depends upon the condition of the oil. Five sheets of dried and oiled paper are placed between each filter plate and the adjacent frame, and the whole pressed tightly together by means of the screw and lever. When the oil is wet and dirty the paper should be renewed at least once every half hour, but once per hour is sufficient for fairly clean and dry oil. The press may be operated continuously by discarding the first sheet and inserting a new sheet at the end of each set, thus moving the second sheet up into the place previously occupied by the first sheet.

It is usually found after three displacements that the dielectric strength of the oil is apt to fall off, and that it is best to renew the entire charge of paper. If this procedure is followed four charges are obtained from a total of eight sheets per set, or at the rate of two sheets per charge and100 gallons or more of oil are filtered per pound of paper.

The geared pumps give practically constant volume, though the flow decreases somewhat with the pressure, and these pumps will not give more than the rated flow in any circumstances. Should the filter become clogged with dirt so that the pressure rises to 100 lb., the relief valve opens and allows only part of the total flow to pass to the filter. It is advisable, therefore, when using geared pumps, to renew the filter paper frequently. With centrifugal pumps, on the other hand, the flow is greatly increased when the pressure is low so that the rated capacity is exceeded under favourable conditions.

With clean oil the pressure and volume will remain nearly constant, the volume being nearly proportional to the pressure, but with dirty oil the pressure will increase very rapidly, accompanied in general by a decrease in volume. As the volume increases much more slowly than the pressure there is little to gain by an increase in pressure above 75 lb. per sq. in.

It is preferable for the oil to flow into the pumps by gravity, though they will lift the oil about 10 ft. by suction if first primed. Under suction the pumps will not give their full rated output, and, if used, suction pipes must be free from leaks and be both large and straight with a foot valve placed at the bottom.

Either a high suction lift or back pressure in the outlet reduces the effective pressure on the filter and cuts down the flow. The capacity, however, is not much less at 75 than at 100 lb. per sq. ft., and in general, either the geared or the centrifugal pump filters may be used successfully with 10 ft. suction lift and 30 ft. discharge lift.

The dielectric strength of the oil should be taken at frequent intervals to determine when the paper should be renewed to ensure perfect results.

## CURRENT LIMITING REGULATION.

Until quite recently current-limiting regulation was only to be found in very few power stations, though there has existed a definite need for some arrangement which would differentiate between temporary and permanent short circuits so as to prevent unnecessary stoppage of machinery where continuous running is a vital factor—in contrast to the protective devices formerly used, the duty of which was to isolate the damaged section as rapidly as possible. Where the latter devices are used much time has often been lost through unnecessary stoppages.

In the newer devices for selective protection, temporary disturbances are removed by an automatic decrease in the voltage, and after their disappearance the normal working pressure is again automatically restored. As before, during continuous disturbances, relays come into operation and isolate the damaged part from the part carrying current. By using a current limiting regulator the effect of the disturbance is, however, reduced and the strains imposed on the oil switch upon interruption of the current considerably diminished. In addition, the generators and circuits under current are protected and parallel operation is preserved, due to the gradual re-establishment of the voltage. It is mainly in this respect that the earlier prevalent suppositions are incorrect. According to these, the influence of the current limiting regulator was to interrupt the parallel operation of the synchronous plant.

It is quite correct to assume that with instantaneous-acting absolutely reliable selective relays a fault could be isolated more quickly and the disturbance suppressed earlier than is possible with the current limiting regulator and graduated time relay. Experience has shown, however, that with the exception of networks protected by special pilot leads and fault relays, which arrangements are expensive, the relays often employed have not always given that degree of safety of operation and selectivity which would enable them to be entirely relied upon to perform only such tripping as is absolutely necessary.

It must also be remembered that with overhead lines the majority of disturbances are of a temporary nature. In many networks an immediate tripping on the occurrence of every temporary fault would lead to a general closing down. In such instances it is preferred in the case of a continuous short circuit to employ a relay with a somewhat larger time lag rather than to have unnecessary switching-out operations and interruptions.

## POWER TRANSFORMER RATIO ADJUSTERS.

Power transformers have often to be provided with some means of adjusting the ratio of transformation in order to cope with variations in the supply voltage, and for this purpose it is usual to bring out taps from the winding and make arrangements for connecting them together in different combinations so as to vary the number of turns in one of the windings. To overcome the obvious objections to such a method, the B.T.H. Co. have adopted on their transformers what is known as a ratio adjuster which is used for connecting the taps together.

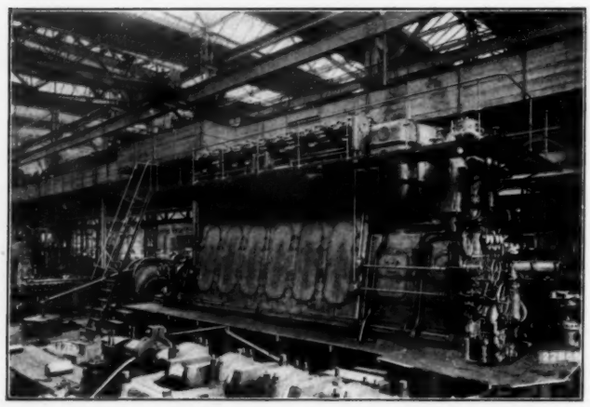
This mechanism employs a cranked spindle, placed vertically in the centre of two circular blocks of moulded compound spaced a suitable distance apart. Several metal tubes, equally spaced, are arranged around the outer circumference of the

circular blocks, thus forming a cage-like structure. The tubes project through the bottom block and the tap leads are sweated into them. Several metal tubular rollers, the number varying with the current rating of the ratio adjuster, are mounted on the eccentric portion of the spindle previously referred to. A spring is fixed inside each of these rollers so that when the spindle is rotated the rollers ride over the metal tubes, and, on coming to rest between the particular pair of tubes which gives the desired tap change, the springs keep the rollers pressed hard against the tubes, thus ensuring a good contact. The spindle itself carries no current.

The complete mechanism is housed inside an insulating cylinder and the spindle is operated by an extension shaft made of an insulating material, and having at the upper end a knob fitted with a pointer. An indicating dial over which the pointer moves is mounted just below the knob. The pointer thus indicates the position of the rollers and therefore the effective tapping. The knob and indicating dial may be placed either inside or outside the transformer cover as required.

### EUROPEAN-BUILT YACHTS FOR AMERICAN OWNERS.

Since the war several large motor yachts have been built in European yards for American owners, one of the best known being the "Crusader," constructed in the Southampton yards of Camper & Nicholson, for Mr. A. K. Macomber. This vessel was built to comply with the highest classification of Lloyds Register. It is propelled by two Sulzer two-cycle engines of the usual type developing a total of 1,050 i.h.p. when running at 200 r.p.m. The speed of the yacht is 13 knots, and sufficient fuel can be bunkered to give a radius of action of 6,000 miles.



One of the 2,100 i.h.p. Sulzer two-cycle Diesel Marine Engines on the test bed. For Mr. Vincent Astor's new motor yacht.

A further yacht for a well-known American, Mr. Vincent Astor, is now in course of construction at a German yard. This yacht will be propelled by two six-cylinder Sulzer two-cycle Diesel engines, each of 2,100 i.h.p., giving the vessel a speed of 15½ knots. The auxiliary plant for the yacht consists of a 100 b.h.p. airless-injection two-cycle engine, coupled with a dynamo and an air compressor, also two 50 b.h.p. engines of the same type, each coupled with a dynamo, and finally a small motor compressor.

### GENERATING ELECTRICITY WITH DIESEL ENGINES.

It is of interest to note that the report compiled by the Diesel Engine Users' Association shows that the lowest running costs in the country for Diesel engines are obtained in the works of Messrs. Crompton and Co., Ltd. At these works three 550 b.h.p. four-cycle Sulzer Diesel engines are used, each engine being direct coupled to a Crompton 370 k.w. d.c. dynamo, and mounted on the shaft between the engine and the dynamo is a flywheel designed for a coefficient of fluctuation of 1 : 200. The load on the plant fluctuates considerably owing mainly to the varying demands of the test beds in the works, and in order to ensure perfect combustion at all loads the Diesel engines are fitted with the Sulzer patent system of injection air regulation.

To obviate any possibility of an engine racing, a safety governor is installed, which cuts off the fuel if the speed rises by about 20 per cent. above normal, thereby stopping the engine. The cooling water from the engines is discharged into a shallow tank of large area and then re-used.

For twelve months covered by a recent report of the Diesel Engine Users' Association, 1,249,618 units (k.w.-hours) were generated in 5,553 engine hours with a consumption of 0.716 lb. of fuel and 0.00087 gal. of lubricating oil per unit generated. The running costs amounted to 0.491 pence per unit, and the next lowest figure recorded by the Association was 0.65d. per unit, or about 30 per cent. higher than that obtained by Messrs. Crompton.

## Port of Southampton Topics.

### FRUIT TRADE.

Port authorities at Southampton have good reason to be interested in the fact that the fruit season at the Cape promises to be an exceptionally good one. There is no other port which handles as many of these consignments and the development of the trade has been responsive to the facilities which have been provided at the port. Union-Castle liners bring over very large cargoes of fruit from South Africa besides the quantities shipped by other vessels. The growth of the trade is evidenced by the fact that, whereas in 1913 the total deciduous fruit imported into this country was about 250,000 boxes, last year the total was over a million and a half. The greater portion of this amount passed through Southampton, and it is confidently hoped that this year the imports will constitute a record. Nearly 200,000 cases of South African fruit were discharged from three vessels during recent weeks.

### HAMBLE RIVER IMPROVEMENT.

Several suggestions for improving facilities in Hamble River have been submitted to the Southampton Harbour Board by the Hamble River Navigation and Improvement Committee, which recently came into existence. The state of the river and its present management, says the committee, are such that a number of yacht owners and others have been led to recommend the need for these improvements. In view of the fact that the river will in all probability be called upon to accommodate the vessels which will be displaced from their present berthing place by the extension of the docks, the matter is important. The need for proper regulations for assisting in keeping the fairway entirely open to all kinds of navigation is urged, and it is thought that a few more booms would be advisable. Owing to the great increase in the number of vessels using the Hamble River it is suggested that more boating berths might be found by dredging at certain spots. It will be remembered that Comdr. Irving, the well-known harbour surveyor, undertook a detailed survey of the river and submitted to the committee far-reaching proposals for its improvement. Not all of his suggestions have been contained in proposals made to the Harbour Board.

### SOUTHAMPTON OR PLYMOUTH?

Speculation has been rife among shipping men in the port as to the significance of the announcement that the Hamburg-America Line are sending one of their new motor ships to Southampton when she makes her maiden voyage to the West Indies in April. The service to Trinidad has hitherto had its English connection at Plymouth, where the vessels have called both outwards and inwards, but it has not yet been discovered whether the Hamburg-America Line have decided to transfer their outward vessels on this run from Plymouth to Southampton. It would be unusual for a company to change its port of call just for one sailing, and the view is strongly held that before long Southampton will be chosen to take the place of Plymouth on the outward service. The vessel to make this maiden voyage is the "Orinoco," and she will be the first vessel on the West Indies branch of the service to call at the port. The "Orinoco" is a twin screw motor vessel of about 9,000 tons, with 6,500 h.p. engines, which will give her a speed of 15 knots.

### THE DUTCH CARGO TRADE.

The " dead " season in dockland has not been nearly so quiet this year as in past years for, despite the long-continued absence of some of the best-known ships, which are on cruises, there have been a number of interesting new arrivals. Most of these have been ladened with big cargoes. A handsome new passenger ship, the "Sibajak," has been speeded on her maiden voyage, and the Nederland Royal Mail Line's " Christiana Huygens," which is the largest vessel in the Java passenger trade, also paid a call. The Dutch boats do a very large cargo trade at Southampton. They take aboard about 1,000 tons of cargo every week and the service to the Dutch East Indies is appreciated by British manufacturers, who, in increasing numbers, are shipping through Southampton.

### NEW SHIPS AND NEW PORTS.

Within a few months the German African service from Southampton will have in commission two fine large vessels which will take their place on the South and East Africa service. This will enable two of the vessels now employed on that run—the "Wangoni" and "Ussukuma"—to be released, and they will be transferred to the West African service. This latter service will thereby be considerably strengthened and improved. In connection with the itinerary of this service it is interesting to note that one of the places at which a call will be made is Sekondi—Takoradi, to which Messrs. Day, Summers and Co., of Northam, despatched one of their slipways for use in the new harbour. The construction of this harbour was entrusted to Sir Robert McAlpine & Sons, and modern mechanical devices have been utilised to develop the natural facilities at Takoradi.

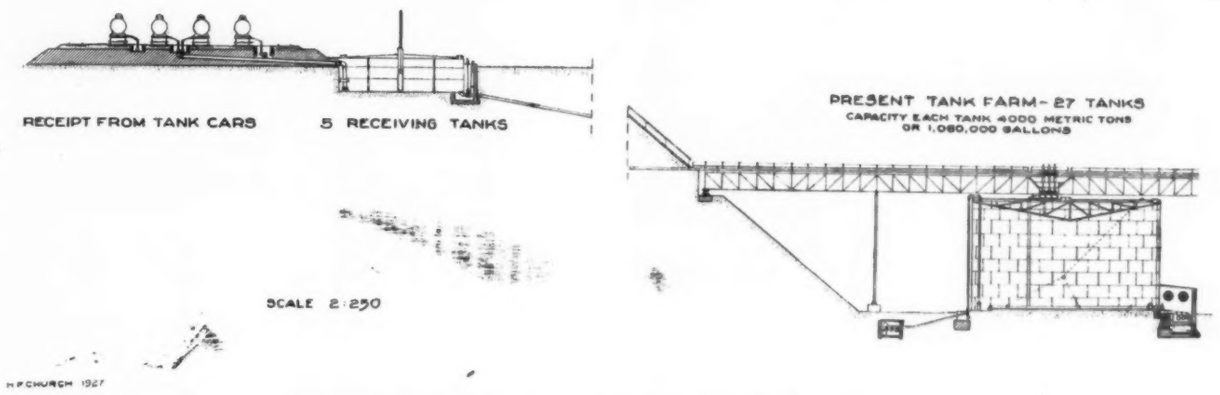
# The Ports of Rumania.

## *III.—The Port of Constanza.*

By ROY S. MAC ELWEE, Commissioner of Port Development, Charleston, South Carolina, B.S., M.A., Ph.D. Maps and Drawings by HENRY F. CHURCH, Assistant Commissioner Bureau of Port Development, Charleston, South Carolina.

*(Continued from page 149.)*

### PETROLEUM PRODUCTS HARBOUR, PORT OF CONSTANZA, RUMANIA.




Diagrams illustrating arrangement of the Tank Farm, Oil Port, Constanza.

### THE HARBOUR AND ITS EQUIPMENT.

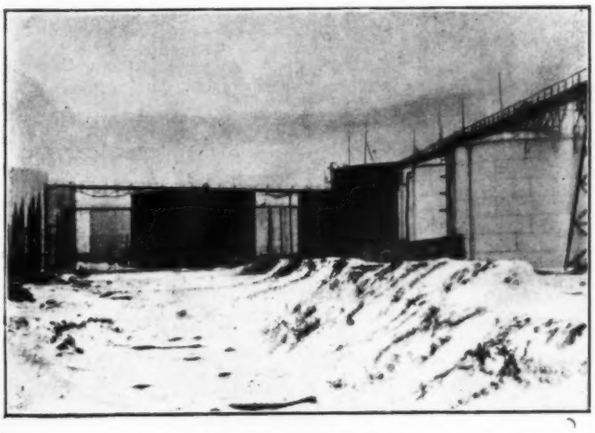
CONSTANZA, the chief port, the all-year-round port, and the only strictly *sea* port of Rumania, is a thoroughly modern, artificial breakwater harbour. It is the first passenger and petroleum products port of the kingdom. It has direct railway connections with Bucharest.

The town of Constanza, on a high cliff forming the peninsula and Cape Constanza, overlooking the Black Sea, is Rumania's chief seashore summer resort.

The total commerce in 1926 was 1,806,000 metric tons (at 2204.6 lbs.), the greatest year in its history.

### HARBOUR WORKS.

The protection afforded to the shore in the shallow bay by this peninsula was the nucleus of the present modern seaport. The extensive port works were begun in 1896. The protection of the peninsula was extended to the south by a jetty-breakwater or mole, 1,372 metres long (4,513 ft.). A series of sea walls were constructed from the opposite, western, shore forming an artificial harbour with an entrance parallel with the north and south breakwater, located 402 metres (1,382 ft.) inshore from the sea end and having a width of 160.70 metres (519 ft.). This entrance is marked by flashing approach lights, green right, red left. The sea end of the breakwater carries a high-power flashing beacon visible 14 miles. The harbour is divided into two irregular basins; the north or inner basin, and the south or outer basin, with a channel turning basin of 450 metres (1,490 ft.) diameter. In the left centre of the outer basin a quay-pier, 105 metres (345 ft.) by 500 metres (1,645 ft.) is projected to extend from the west (left) shore. As the water originally extended to the cliffs around the crescent of the bay, fully half of the former shallow bay was filled with dredge spoil from basin and channel to create the essential upland to accommodate rail tracks, grain elevators, transit sheds, etc.



Tank Farm at Oil Port.

The petroleum harbour has since been added outside of the original design.

Future enlargements contemplate a third breakwater basin still farther out to the south.

### THE QUAYS.

The wharves at present available are of masonry quay construction and provide 30 berths averaging 125 metres (411.25 ft.).

| | Metres. | Feet. |
|---|---|---|
| Breakwater berths ... ... ... | No. 0 — 63.25 | 205 |
| | No. 1 — 124.85 | 411.1 |
| | No. 2 — 124.85 | 411.1 |
| | No. 3 — 124.85 | 411.1 |
| | No. 4 — 125 | 411.25 |
| | No. 5 — 119.55 | 393.2 |
| Pier at position of old pre-1906 breakwater | No. 6 — 105.00 | 345.6 |
| | No. 7 — 105.00 | 345.6 |
| | No. 8 — 73.25 across head | 238 |
| | No. 9 — 96.25 | 316.6 |
| | No. 10 — 103.25 | 339.7 |
| Inner harbour, East Quay, general merchandise | No. 11 — 135.00 | 444 |
| | No. 12 — 135.00 | 444 |
| Inner harbour, North Quay, general merchandise and passengers | No. 13 — 112.45 | 365 |
| | No. 14 — 122.00 | 401.2 |
| | No. 15 — 122 00 | 401.2 |
| | No. 16 — 133.80 | 440 |
| Inner harbour, West Quay, grain silos | No. 17 — 120.00 | 394.8 |
| | No. 18 — 108.40 | 356.4 |
| | No. 19 — 108.60 | 356.5 |
| Inner harbour, South Quay ... ... | No. 20 — 121.10 | 396 |
| | No. 21 — 128.80 | 423.7 |
| Channel berth across end ... ... | No. 22 — 95.50 | 314 |
| Outer harbour, North Quay ... ... | No. 23 — 99.75 | 328 |
| | No. 24 — 122.55 | 403.18 |
| | No. 25 — 125.00 | 411.25 |
| | No. 26 — 125.00 | 411.25 |
| | No. 27 — 125.00 | 411.25 |
| Outer harbour, South Quay ... ... | No. 36 — 151.65 | 498.9 |
| | No. 37 — 151.70 | 498.9 |
| | No. 38 — 151.65 | 498.9 |
| Petroleum basin ... ... ... | (North) — 150.00 | 496 |
| Approach on ante chamber dock ... | (South) — 161.52 | 531 |
| Basin ... .. ... ... ... | (West) — 115.34 | 380 |
| | (North) — 270.00 | 886 |
| (1 M equals 3.23 ft.) ... ... ... | (South) — 270.00 | 886 |

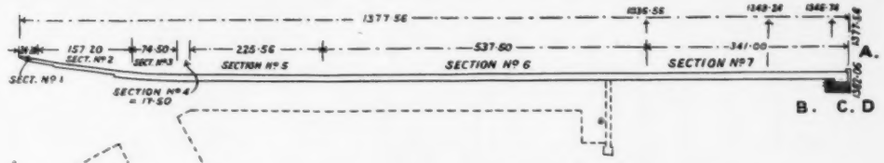
Depth of water 7½ (24.7 ft ) and 8 (26.3 ft.) metres.

### PLANS FOR PORT EXTENSIONS.

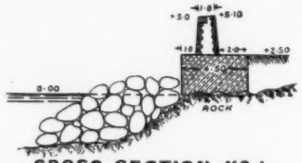
A third or outer south basin is projected (April 1st, 1924) that will be accomplished by extending the jetty breakwater south 710 metres (2,293.3 ft.) to a new entrance and an additional 550 metres to form the necessary harbour entrance protection, the prevailing storm winds being S.S.E. The new harbour will be closed by a new south breakwater extending from the western shore 1,150 metres (3,783.5 ft.), West by North, 360 metres (1,184.4 ft.) W.N.W., and 130 metres (429 ft.) West. The entrance is 160 metres (516 ft.) in width, and a short mole 85

# PORT OF CONSTANZA, RUMANIA.

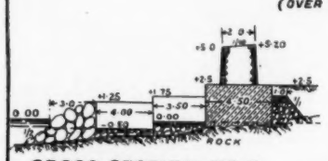
## TYPICAL SECTIONS OF THE MAIN BREAKWATER.



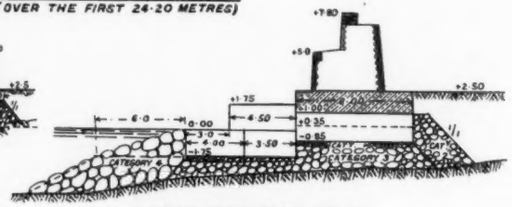

PLAN OF BREAKWATER.



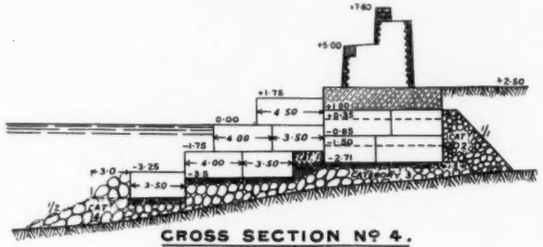

CROSS SECTION Nº 1.
(OVER THE FIRST 24·20 METRES)



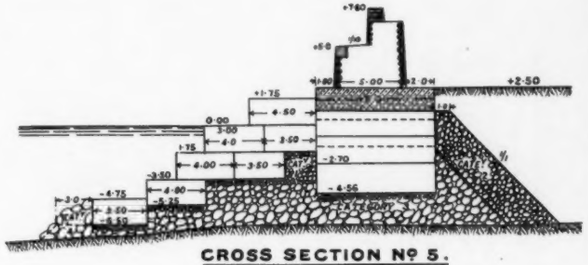

CROSS SECTION Nº 2.
(FROM 24·20 M. TO 181·50 M.)



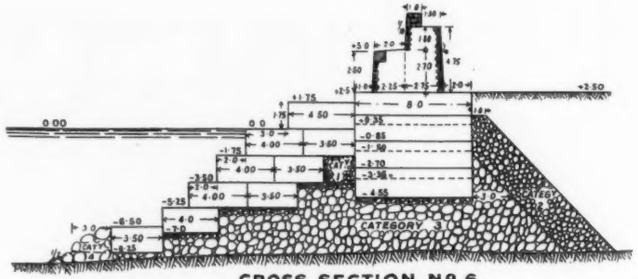

CROSS SECTION Nº 3.
(FROM 181·50 M TO 256·0 M.)



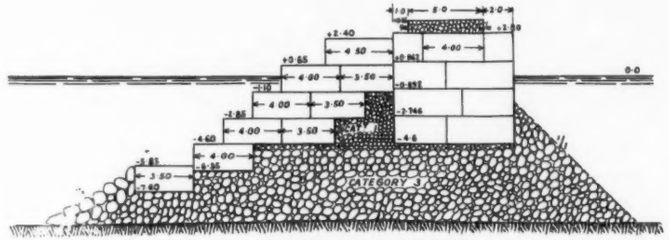

CROSS SECTION Nº 4.
(FROM 256·0 M. TO 273·50 M.)



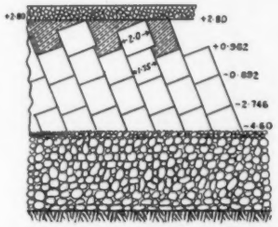

CROSS SECTION Nº 5.
(FROM 273·50 M. TO 499·06 M.)



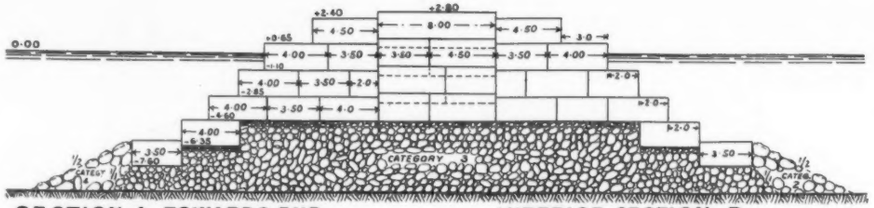

CROSS SECTION Nº 6.
(FROM 499·06 M. TO 1036·56 M.)




CROSS SECTION Nº 7.
(FROM 1036·56 M. TO 1249·24 M.)

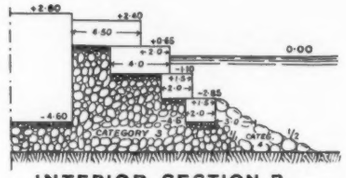


LONGITUDINAL SECTION.

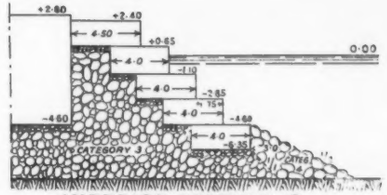



SECTION A. TOWARDS END.
AT 1377·56 M.

INTERIOR SECTION D.
(FROM 1377·56 M. TO 1382·06 M.)




INTERIOR SECTION B.
(FROM 1249·24 M. TO 1346·74 M.)




INTERIOR SECTION C.
(FROM 1346·74 M. TO 1377·56 M.)

metres (282 ft.) West to the N. and S. breakwater. The arrangement of this harbour provides a main channel and turning basin 450 metres (1,480 ft.) in width, a south channel inside the south breakwater 450 metres (1,480 ft.) wide to reach a series of five quay piers running approximately north and south.

The three full-width quay-piers are designed to be 500 metres (1,645 ft.) by 100 metres (329 ft.). The channel or east pier is a jetty-pier 50 metres (164.5 ft.) by 500 metres (1,645 ft.), with a west quay 750 metres (2,482.5 ft.) long. The west pier 84 metres (275.32 ft.) wide with the west quay and basin 350 metres (1,151.5 ft.) long These dimensions give a pier of approximately the size of the two piers of the Army Supply Base at Norfolk, U.S.A. Each quay has four berths of 125 metres (411.25 ft.) in length, a total of 36 berths in basins for this group. The outside or jetty berths add 14 more. The new harbour will, therefore, afford 50 more berths.

The quay-piers will be equipped with two railroad tracks on each quay at shipside, a central draw-way and two transit sheds for each berth, set back about 30 ft. from the water's edge. The mole or jetty berths are provided with tracks, but are left without sheds for heavy or coarse material handled in the open.

Provision is made for industrial development in an area of filled land to the west, where 20 hectares (50 acres) are set aside for that purpose in addition to space for train yards.

The port extension of Constanza gladdens the heart of the modernists in terminal engineering who advocate the quay-pier system of port layout. It is a perfect example.

## FACILITIES AT THE PORT.

The present and future accommodations of the Port of Constanza are compared as follows:—

| | Present Port. | When present construction is completed. | When future Plans are completed. |
|---|---|---|---|
| 1. Water area within port ... | 150 acres | 150 acres | 400 acres |
| 2. Water area of ante port ... | 35 acres | 35 acres | 55 acres |
| 3. Length of quays ... ... | 14,482 ft. | 19,408 ft. | 41,783 ft. |
| 4. Number of berths ... ... | 32 | 43 | 95 |
| 5. (a) Area of quay space ... | 35 acres | 60 acres | 135 acres |
| (b) Area for special terminals | 170 acres | 170 acres | 220 acres |
| (c) Reserved area ... ... | 65 acres | 65 acres | 115 acres |
| Total ... ... ... ... | 270 acres | 295 acres | 470 acres |
| 6. Length of harbour belt railroad ... ... ... ... | 20.6 miles | 37.5 miles | 62.5 miles |
| 7. Area of transit sheds ... ... | 194,000 sq. ft. | 430,400 sq. ft. | 645,600 sq. ft. |
| Plus two-storied bonded warehouse ... ... ... ... | — | 161,400 sq. ft. | 322,400 sq. ft. |
| 8. Mechanical steam power of central plant (in metric h.p.) (1 m.p.h. = .985 h.p. U.S.A.) | 1,600 m.p.h. | 4,800 m.p.h. | 6,000 m.p.h. |
| 9. Electrical power of central plant (4 sets of 440 v. and 300 amp. each) ... ... | 528 kw. | 3,500 kw. | 4,200 kw. |
| 10. Capacity of grain elevators (1 elevator unit of 30,000 tons = ca 1,200,000 bu.) (1 ton = 40 bu. ca) ... ... | 2,400,000 bu. | 4,800,000 bu. | 4,800,000 bu. |
| 11. Elevating capacity per elevator unit ... ... ... | 6,000 bu. per hr. | 6,000 bu. per hr. | 6,000 bu. per hr. |
| 12. Delivery capacity per elevator unit ... ... ... ... | 12,000 bu. | 12,000 bu. | 12,000 bu. |
| 13. Capacity of petroleum tanks (1 metric ton = 265 galls.) (27 tanks of 4,000 metric T.) 1,060,000 galls. ... (60 tanks of 4,000 metric T.) (80 tanks of 4,000 metric T.) | 31,270,000 galls. | 63,600,000 galls. | 78,800,000 galls. |
| 14. Pumping capacity to storage of refined petroleum products (160 tons per hour) ... | 42,400 galls. | 42,400 galls. | 42,400 galls. |
| 15. Pumping capacity to shipside delivery of petroleum products ... ... .. ... | 42,400 galls. | 42,400 galls. | 42,400 galls. |
| 16. Minimum depth alongside quays. Draught of vessels which can operate at dock... | 26 ft. | 27 ft. | 27 ft. |
| 17. Minimum depth petroleum basin. Draught of vessel which can operate at petroleum reservoir ... ... | 29 ft. | 30 ft. | 31 ft. |
| 18. Hangar for housing vessels up to 1,000 tons ... ... ... | 1 | 1 | 1 |
| 19. Traffic capacity of the port (present docks not utilised to capacity) ... ... ... | 1,500,000 tons per year. | 4,000,000 tons per year. | 15,000,000 tons per year |
| 20. Floating dry docks ... ... | None. | None. | 1 |

## QUAY EQUIPMENT.

The first structure on the right at the harbour entrance is in contrast to the strictly commercial nature of the port. The Royal Family are all fond of the sea, especially the late Queen Mother. What could be nearer the sea nor more secluded and tranquil, yet with the constant changing of panorama of ships from every clime entering and leaving the harbour than a pavilion at the end of a harbour breakwater! The proverbial loneliness and isolation of the lighthouse keeper is recreation and ceases to be monotonous work when enjoyed voluntarily and to be terminated at will or change of fancy. The pavilion is built out on brackets to give the necessary floor area sufficient for a roomy, thoroughly modern bungalow. The members of the Royal Family retreat to this lighthouse on a rock and enjoy the cooling sea breeze, the lapping of waves against the jetty under the windows, and tranquillity.

Pipe Line Trestles to Storage Tanks.

The long jetty-quay is equipped with a drive-way, railway tracks, and one small transit shed. The quay is 52 metres (171 ft.) wide.

The quays are of the usual permanent type, constructed of 40-ton pre-cast concrete blocks and trimmed with stone.

The new mole (N.E. to S.W.) is supplied with shipside tracks and transit sheds Nos. 10 and 11.

Quay S.M. R. shows shipside tracks, but aside from an office, is open storage.

North Quay, opposite the entrance, is the chief passenger and general merchandise wharf. Here is located transit sheds Nos. 1, 2, 3, 4, 5 and the Customs House. Along this quay are moored the Royal Rumanian State Line passenger vessels to Alexandria via Constantinople, Piraeus, with the "s.s. Imperatul Trian," "s.s. Regele Carol I.," or "s.s. Romaina" every two weeks, or with the "s.s. Dacua" fortnightly to Constantinople, Piraeus, Haifa and Jaffa. These are small, trim, fast steamers with good food and quarters.

The Cereals Mole is equipped with sheds, open storage, and several cranes of heavy duty capacities for heavier merchandise, automobiles, machinery, etc. Mr. Habermann's "American Export Line" vessels use this quay.

The administration building near the north-west corner of the basin, as usual in Rumanian ports, leaves nothing to be desired in appearance or completeness; exceptionally well designed for the service to be rendered. The contrast with the decidedly provisional, if not ramshackle, head offices of most American ports is most striking.

## GRAIN ELEVATORS AND PETROLEUM HARBOUR.

The grain elevators of Constanza are not only mechanically modern but architecturally monumental. The original plans for the west or Silo Quay, called for four elevators. The elevators are designed for a capacity of 30,000 tons (1,100,000 bu.) each and an elevating capacity of 150 tons (5,500 bu.) an hour and a shipping capacity of 300 tons (11,000 bu.) an hour. The loading gallery extends the length of the quay side, 340 metres (1,120 ft.) (three berths Nos. 17, 18 and 19). The quay wall is 337 metres (1,108 ft.). The loading gallery is connected by a conveyor bridge with each silo-elevator, therefore each silo can serve any berth. Water alongside is 8 metres (26⅛ ft.). Of the 30,000 ton elevators, two are in operation, No. 3 is constructed, but not mechanically equipped. No. 4 is constructed only as far as the foundation out of the ground. When and if the exportable surplus of Rumanian grain comes back to and exceeds pre-War normal, units III. and IV. can be completed and put in commission.

The construction and installation of the grain elevators in principle vary only in a few small but apparent details from modern grain elevators in American ports. A ladder of tracks inshore permits strings of grain-laden box cars to be drilled down the centre line of the elevator, where the cars are tipped

and grain dumped into hoppers to be carried by belt conveyors through cleaning and drying processes then to be elevated to the top of the house by bucket conveyors, and thence by belt conveyors through spouts into the silos or bins. The attic at Constanza is exceptionally high, light, and well ventilated. The silos are not round with small inner cellular bins to take up the lost space, but are hexagonal, like a honeycomb. Each bin is 3 metres (9.8 ft.) across in the clear at the top. There are ten rows of 25, or 250 silos. The overall measurement of each elevator unit is 50 by 108 metres (164.5 by 355.3 ft.) and 47 metres (154.8 ft.) from cellar floor to tower roof, the main roof being 35 metres above the bottom floor. The elevator is equipped with passenger elevators (Stiegler-Milan). The marginal street from elevator units to coping of quay is 29 metres (96 ft.). The quay is provided with railroad tracks to load general merchandise or supplies passing under the loading conveyor, if desired.

Depth of water in the petroleum basin is 29 ft.

As throughout the port of Constanza the equipment of the petroleum harbour is modern and kept in spotless ship-shape condition.

## CONNECTIONS WITH THE HINTERLAND.

The 33 kilometres of harbour railroad connects with the main system of the Rumanian State railroads serving the remainder of the Kingdom. Heavy grades are encountered in reaching the tableland above the port, but no grades of consequence occur until far beyond Bucharest.

The weakness in the railroad transportation situation is in the single track line and the great Carol I. Bridge across the Danube, also single track. A double tracking of the line to Bucharest would still find a bottleneck at this bridge. Also, as in the last war, a springing of this bridge would cut off Constanza absolutely. The Port of Constanza was unable to

## PORT OF CONSTANZA, PETROLEUM HARBOUR.

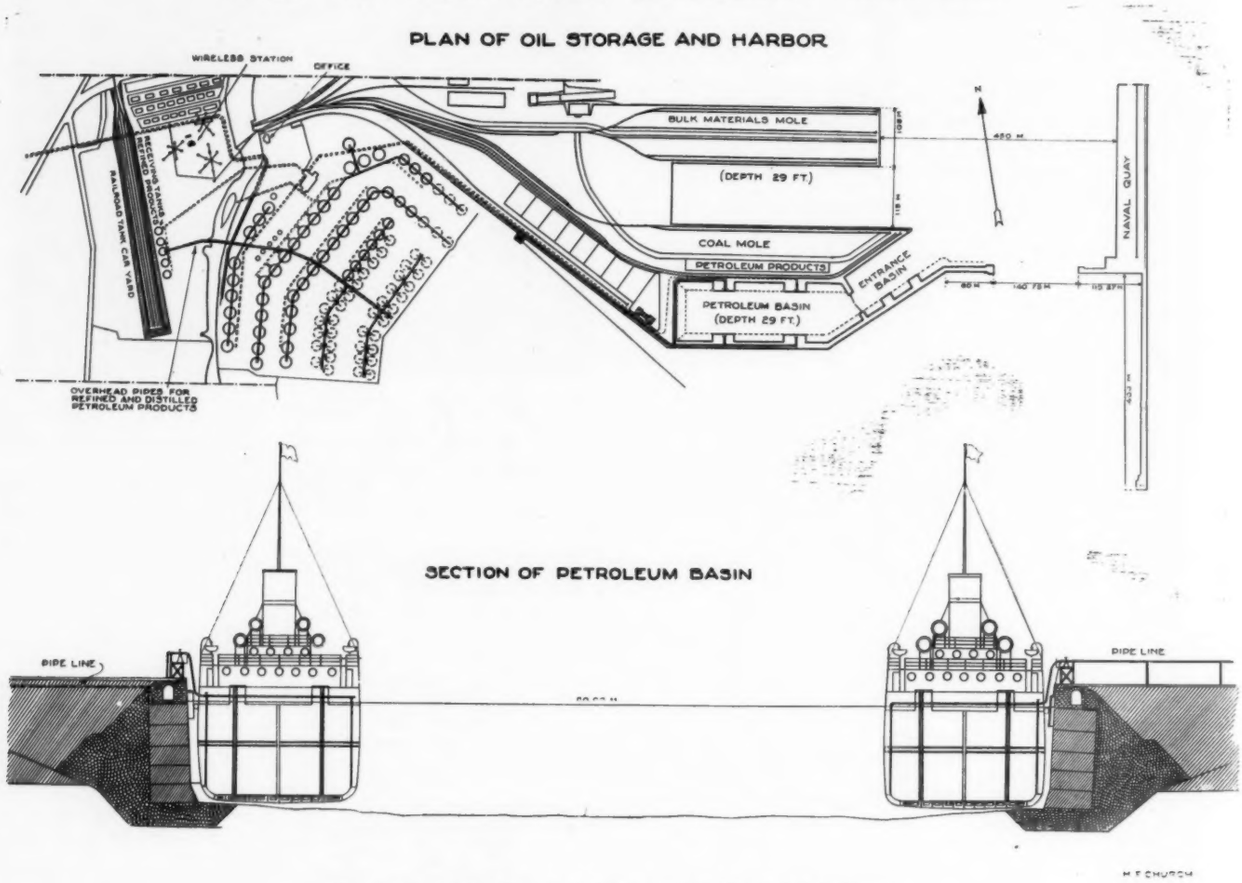



Illustration showing Plan and Basin Section, Oil Port, Constanza.

## PETROLEUM HARBOUR.

Of special interest is the petroleum products basin, tank farm, pumping stations with heaters and the gravity reception from tank cars peculiar to this port, possibly because of the high shoreline.

The tank yard (1927), has 27 reservoir tanks of 4,000 tons (1,060,000 gallons) capacity with 33 more contemplated or under construction, a total future oil storage capacity under the present authorised building program of 120,000 tons for crude oil and refined petroleum products.

Crude and refined oils and distillates are received by several pipe lines from the interior and from tank cars. To accommodate the cars there is a ladder yard of six tracks at the top of the hill. Each car length is provided with a drainage pipe and hose for connecting with the tank car, and by a system of valves the contents of the cars can be directed to any one of five receiving tanks a little farther down the hill. It is customary to use one track for one kind of product as nearly all the time as possible.

From the receiving tanks there are a series of pipe lines carried on trestles to the storage tanks or to the pump house at shore level. From pump house and storage tanks pipe lines reach the petroleum basin for loading into vessels for cargo or bunkers.

The demand for storage is so great that new tanks were being erected throughout the winter, the work (December 27th, 1926) going on in the snow. To accommodate new tanks part of the ocean bed is being filled in outside the present breakwater.

Receipts and deliveries of refined products are at the rate of 160 tons per hour.

renew operations until the war damages to the bridge had been repaired.

The Carol I. Danube Bridge is a great and beautiful span. Its total length is over 12 kilometres, crossing the main channel of the Danube, and its two lesser branches, the Balta and the Borcea. The Danube bridge is 750 metres (2,467.5 ft.), the trestle 912¾ metres (3,002.85 ft.), then about 5 kilometres (16,450 ft.) of filled viaduct. The Balta Bridge low trestle type, is 1,455.80 metres (4,800 ft.) long, then follow 6 kilometres of fill. The Borcea Bridge has 400 metres (1,316 ft.) approach trestle, 420 metres (1,381.8 ft.) bridge, in 3 spans, and 150 metres (493.5 ft.) trestle.

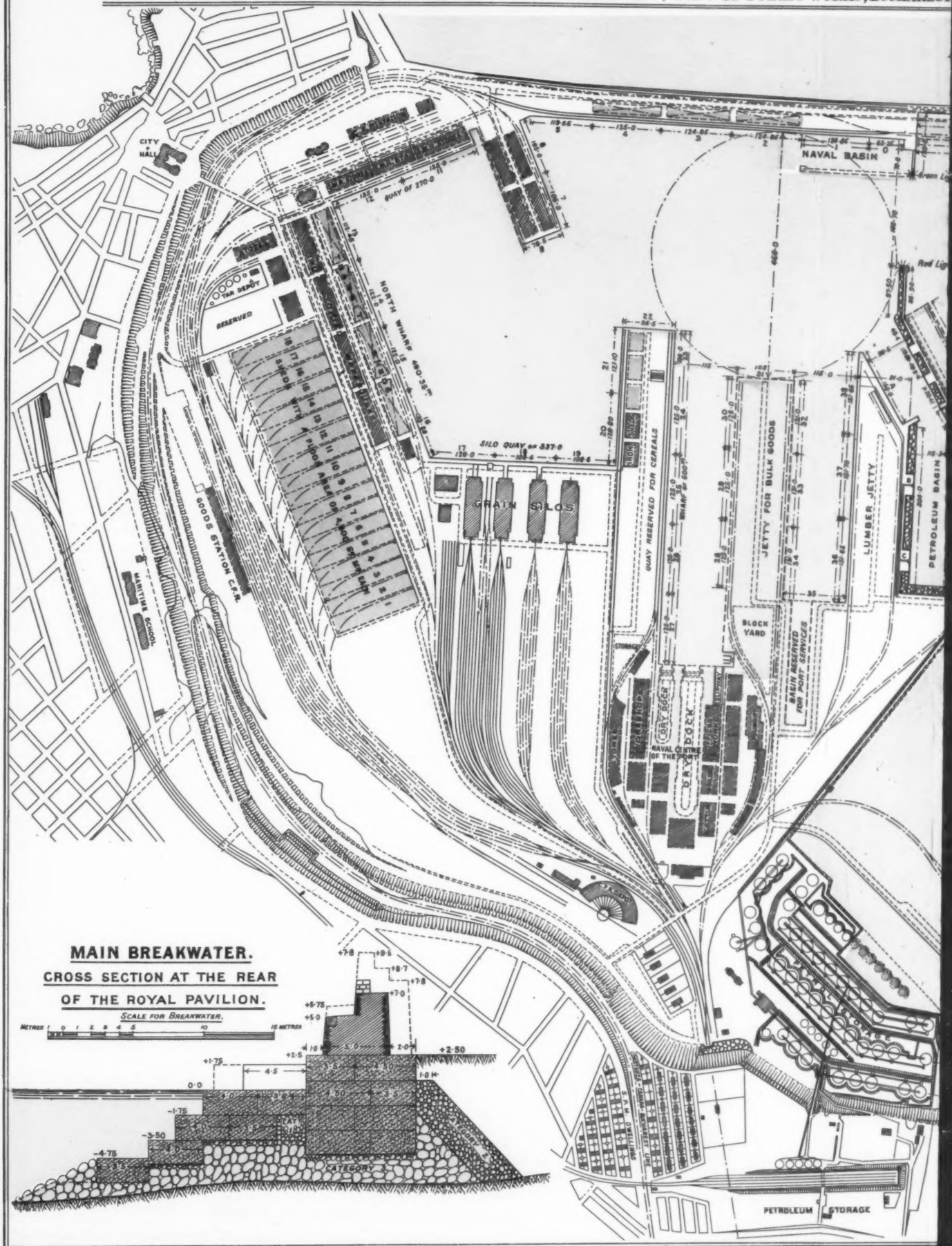
The main bridge is of cantilever construction, similar in appearance to the Quebec—St. Lawrence Bridge. It is carried on four stone towers in stream, and two end towers. The central span is 190 metres (625 ft.), 30 metres (98.7 ft.) clearance above high water April-May, 37 metres (121.7 ft.) above mean low water. The tower footings are sunk to bed rock 25 metres (82.25 ft.) below mean low water. The cantilevers project 50 metres (164.5 ft.), and the central floating truss is 90 metres (296.1 ft.), with a 13 metre (42.78 ft.) cord. The bridge was dedicated September 26th, 1895, and cost 35,000,000 gold lei. Prior to the opening of the bridge, the Dubrudja, the hilly land between the Danube and the Black Sea that makes the Danube flow north at that point, was a wild and isolated No-Man's-Land, and the Port of Constanza did not exist, except for a small fishing village.

## TRAFFIC OF CONSTANZA.

The Port of Constanza (Table II.) exceeds 1,500,000 tons in exports, largely because of the movement of petroleum products

# PORT OF CONSTANZA

*UNDER THE ADMINISTRATION OF THE BUREAU OF PORTS & WATERWAYS, DEPT OF PUBLIC WORKS, BUCHAREST*

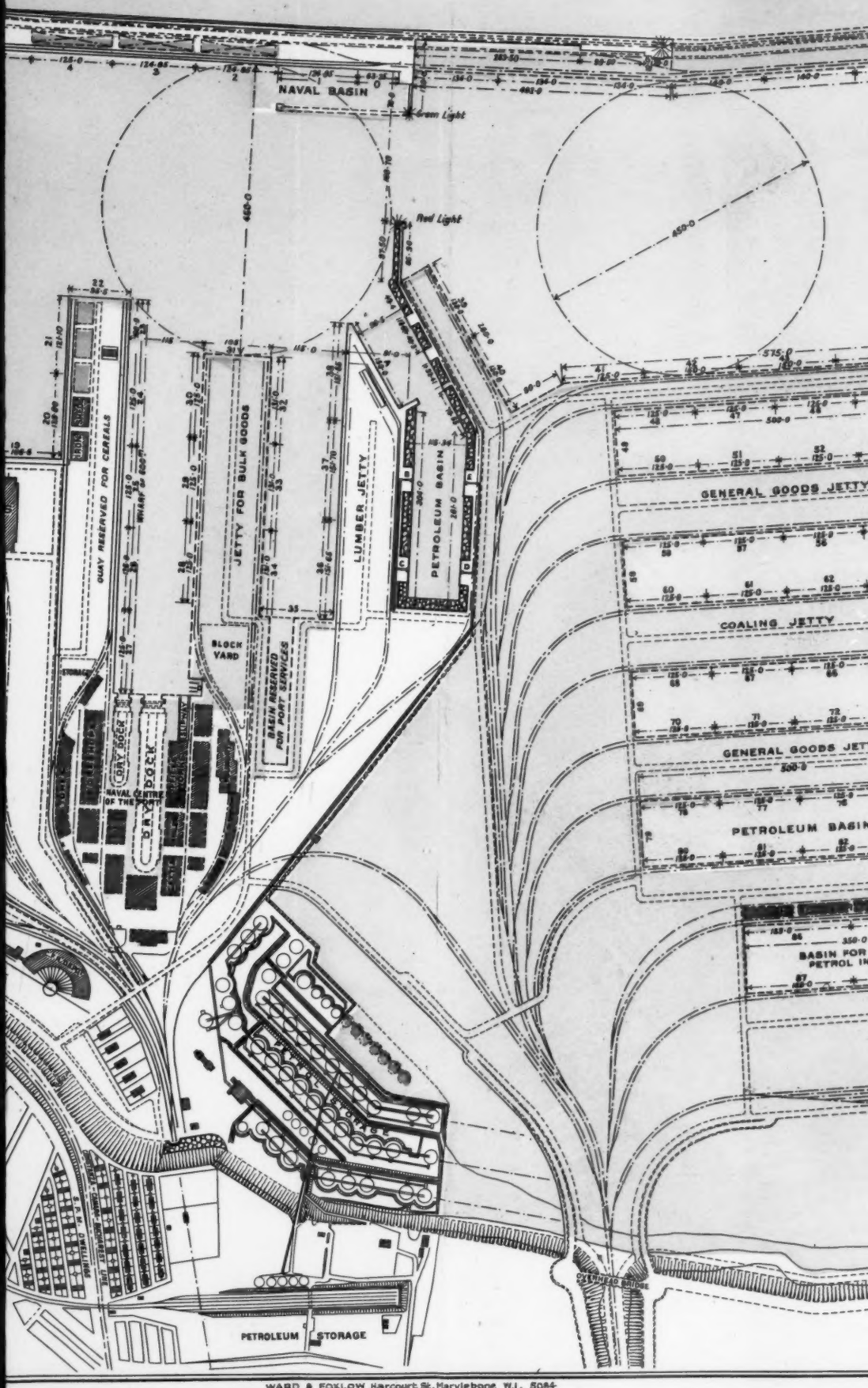



WARD & FOXLOW, Harcourt St. M

TO THE DOCK AND HARBOUR AUTHORITY

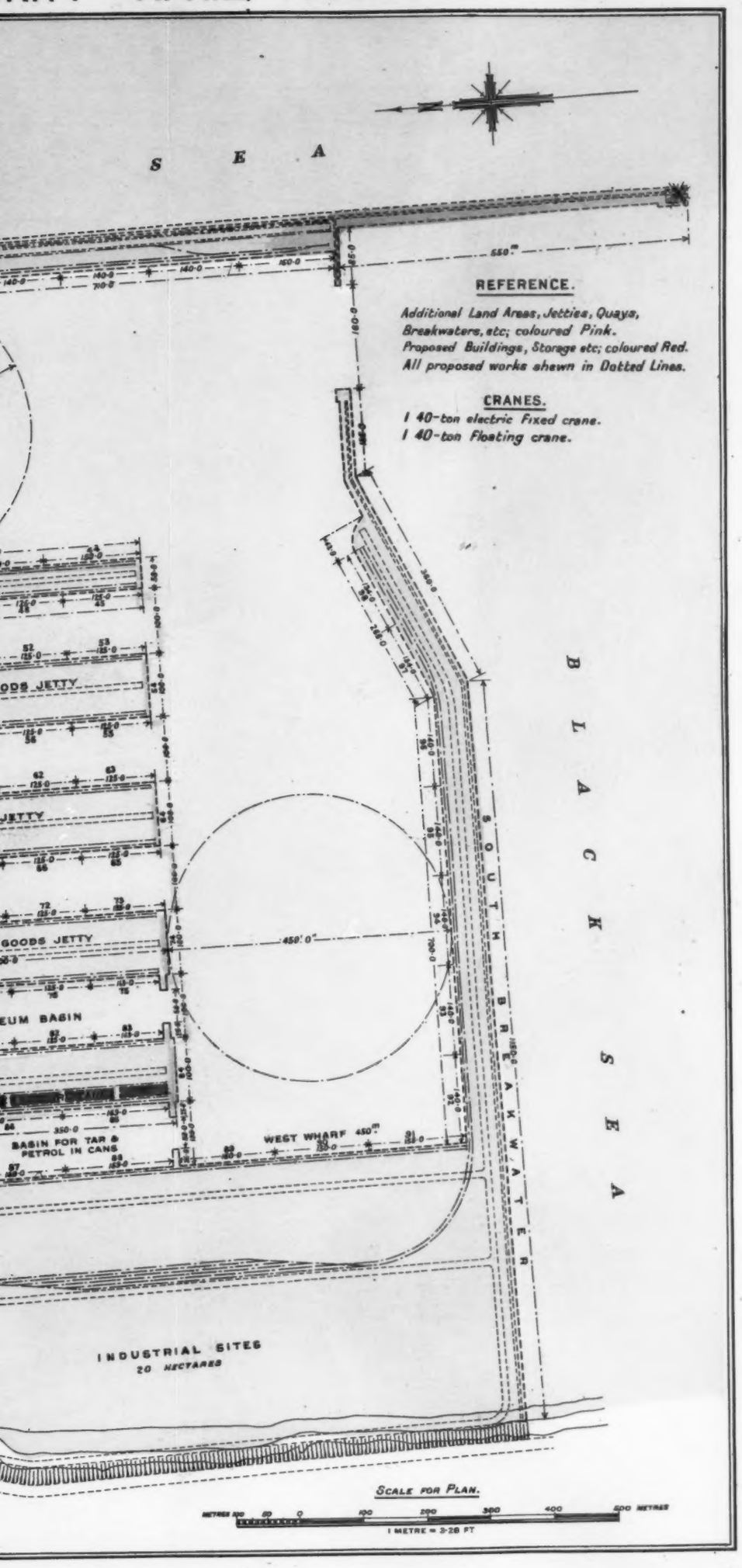
# ONSTANZA.

WATERWAYS, DEPT OF PUBLIC WORKS, BUCHAREST.




WARD & FOXLOW, Harcourt St. Marylebone. W.1. 5084

# ORITY -- APRIL, 1928.



that alone accounts for 1,250,000. It is to this movement that the port is enabled to surpass pre-War normal in the face of the greatly reduced grain exports (Table I). Grain (296,000 tons) is the other important commodity. The imports are less than one quarter million, but comprise about all of the general cargo handled. The analysis of the commodity movements to be handled by the port equipment shows practically a one-way movement over each type of specially designed facilities for grain, petroleum, lumber outbound; passenger and general merchandise facilities inbound, with a small percentage of exceptions. The facilities have all been carefully designed to meet the specialities handled.

**TABLE I.**

Commerce of the Port of Constanza. From 1899-1926.

| Year | Importation Tons | Exportation Tons | Total |
|---|---|---|---|
| 1899 | 142,265 | 74,999 | 217,264 |
| 1900 | 60,963 | 119,152 | 180,115 |
| 1901 | 110,434 | 214,901 | 325,335 |
| 1902 | 55,844 | 372,081 | 427,925 |
| 1903 | 56,263 | 401,095 | 457,358 |
| 1904 | 65,597 | 286,018 | 351,615 |
| 1905 | 165,668 | 520,090 | 685,758 |
| 1906 | 95,508 | 731,641 | 827,149 |
| 1907 | 228,850 | 840,656 | 1,069,506 |
| 1908 | 151,988 | 619,710 | 771,698 |
| 1909 | 89,832 | 694,895 | 784,727 |
| 1910 | 106,382 | 1,168,094 | 1,274,476 |
| 1911 | 146,185 | 1,255,540 | 1,401,725 |
| 1912 | 210,367 | 1,169,230 | 1,379,597 |
| 1913 | 238,611 | 1,140,412 | 1,379,023 |
| 1914* | 112,237 | 426,293 | 538,530 |
| 1915* | ——— | ——— | ——— |
| 1916* | ——— | ——— | ——— |
| 1917* | ——— | ——— | ——— |
| 1918* | ——— | ——— | ——— |
| 1919 | 80,384 | 12,825 | 93,209 |
| 1920 | 88,047 | 236,815 | 324,862 |
| 1921 | 71,358 | 491,227 | 562,585 |
| 1922 | 144,587 | 604,754 | 749,341 |
| 1923† | 85,756 | 369,598 | 455,354 |
| 1924 | 155,006 | 543,068 | 698,074 |
| 1925 | 156,274 | 707,292 | 863,566 |
| 1926 | 234,128 | 1,581,872 | 1,816,000 |

* Period of the War. † For 9 months, April 1st to December 31st.

**TABLE II.**

Imports and Exports of the Port of Constanza. For the years 1925 and 1926 (in metric tons of 2,204 lbs.)

EXPORTS.

| General Merchandise | Tons 1925 | Tons 1926 |
|---|---|---|
| Petroleum and petroleum products | 492,209 | 1,247,419 |
| Grain | 156,314 | 296,200 |
| Lumber | 37,952 | 28,322 |
| Animals | 6,675 | 1,954 |
| All others (misc.) | 14,143 | 7,978 |
| Total | 707,293 | 1,581,873 |

IMPORTS.

| General Merchandise | Tons 1925 | Tons 1926 |
|---|---|---|
| Machinery and mfgs. of iron and steel | 63,561 | 129,913 |
| Coal | 26,192 | 31,904 |
| Manufactured articles | 6,523 | 11,140 |
| Foodstuffs | 29,477 | 29,210 |
| All others (misc.) | 30,521 | 31,962 |
| Total | 156,274 | 234,129 |

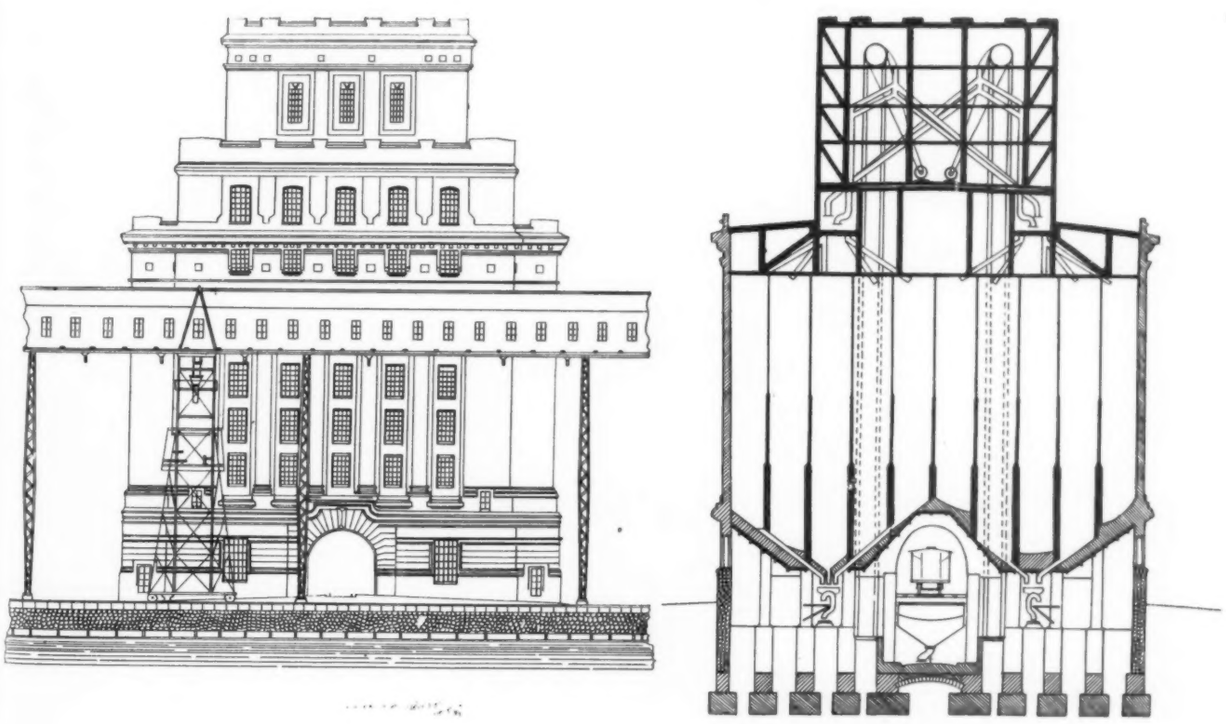
**TABLE III.**

Revenue of the Port of Constanza.

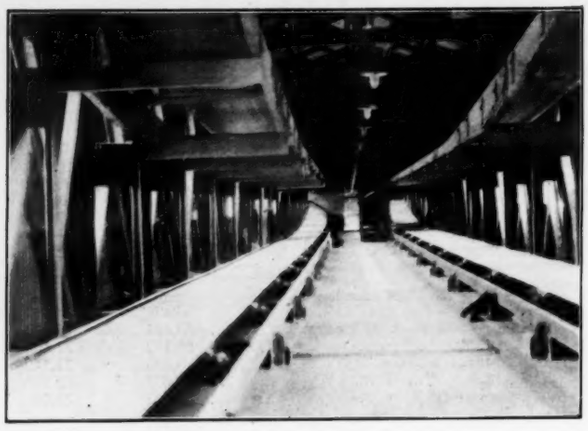
| Year. | Revenues. | |
|---|---|---|
| 1909 | Gold lei or 1,224,828.89 | at 5 lei equalling $1.00 |
| 1910 | ,, 2,931,574.86 | ,, ,, ,, |
| 1911 | ,, 3,529,203.70 | ,, ,, ,, |
| 1912 | ,, 2,143,651.97 | ,, ,, ,, |
| 1913 | ,, 3,223,416.40 | ,, ,, ,, |
| 1914 | ,, 1,270,834.95 | ,, ,, ,, |
| 1915 | ,, 1,006,461.60 | ,, ,, ,, |
| 1916 | ,, 354,475.65 | (From Aug. 16 to Dec. 1, 1916, to |
| 1917 | — | Dec. 1, 1918, the traffic of the port |
| 1918 | Lei (paper) or 85,627.90 | suspended because of the War. |
| 1919 | ,, 1,063,068.91 | |
| 1920 | ,, 6,099,253.25 | |
| 1921 | ,, 20,002,654.20 | |
| 1922 | ,, 32,119,775.65 | |
| 1923 (9 months) | ,, 34,683,066.70 | (April 1 to Dec. 31, 1923) |
| 1924 (12 months) | ,, 61,248,783.60 | (Jan. 1 to Dec. 31, 1925) |
| 1925 | ,, 75,578,301.20 | |
| 1926 | ,, 141,726,023.40 | at 220 lie equalling $1.00 |

This is interesting but does not mean much in exact values, yet it presents a picture of financial difficulties with falling of paper currencies.

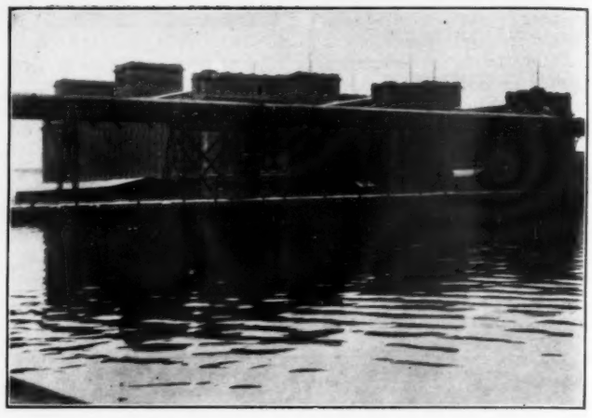
## PORT OF CONSTANZA, GRAIN ELEVATOR.




Sea Front Facade and Transverse Section of Grain Elevator.



Interior of Grain Conveyor Galleries.



Grain Elevators at the Port of Constanza.

**TABLE IV.**

Number of Vessels entering the Port of Constanza, 1904-1926.

| Year | Rumanian Flag Number | Rumanian Flag Tonnage | Foreign Flags Number | Foreign Flags Tonnage | Total Number | Total Tonnage |
|---|---|---|---|---|---|---|
| 1904 | 116 | 92,328 | 506 | 635,351 | 622 | 727,679 |
| 1905 | 114 | 104,923 | 577 | 744,783 | 691 | 849,706 |
| 1906 | 113 | 112,645 | 647 | 341,188 | 760 | 953,833 |
| 1907 | 113 | 129,706 | 689 | 886,267 | 802 | 1,015,973 |
| 1908 | 122 | 125,427 | 642 | 764,307 | 764 | 889,734 |
| 1909 | 131 | 128,934 | 602 | 808,527 | 733 | 937,461 |
| 1910 | 131 | 134,318 | 712 | 992,879 | 843 | 1,127,228 |
| 1911 | 165 | 155,768 | 831 | 1,093,413 | 996 | 1,249,181 |
| 1912 | 229 | 195,464 | 777 | 1,042,106 | 1006 | 1,237,570 |
| 1913 | 290 | 308,059 | 876 | 1,151,942 | 1166 | 1,460,001 |
| 1914* | 298 | ——— | 669 | ——— | 967 | ——— |
| 1915* | 43 | ——— | 391 | ——— | 434 | ——— |
| 1916* | 13 | ——— | 307 | ——— | 520 | ——— |
| 1917 | — | ——— | — | ——— | — | ——— |
| 1918 | — | ——— | — | ——— | — | ——— |
| 1919 | 239 | ——— | 255 | ——— | 944 | ——— |
| 1920 | 67 | ——— | 119 | ——— | 186 | ——— |
| 1921 | 144 | 166,896 | 748 | 1.367,344 | 892 | 1,534,240 |
| 1922 | 176 | 290,500 | 761 | 1.331.750 | 937 | 1.622,250 |
| 1923 | 139 | 147,416 | 554 | 1,087,154 | 693 | 1,234,570 |
| 1924 | 169 | 300,989 | 722 | 1,285,882 | 891 | 1,586,871 |
| 1925 | 230 | 407,330 | 810 | 1,429,650 | 1040 | 1,836,980 |
| 1926 | 232 | 443,030 | 945 | 1,745,160 | 1177 | 2,188,190 |

* Period of the War.

## NATIONAL ECONOMY AND THE DIVISION OF RUMANIAN FOREIGN TRADE AMONG ITS PORTS.

The foreign commerce of Rumania consists primarily of the exports of the three principal native products: grain, lumber and petroleum products. The other exports do not bulk very heavy in tonnage, but are of considerable value. These consist primarily in the exquisite peasant embroidery and the fine home spun linens, cottons and home-grown silks, and caviare.

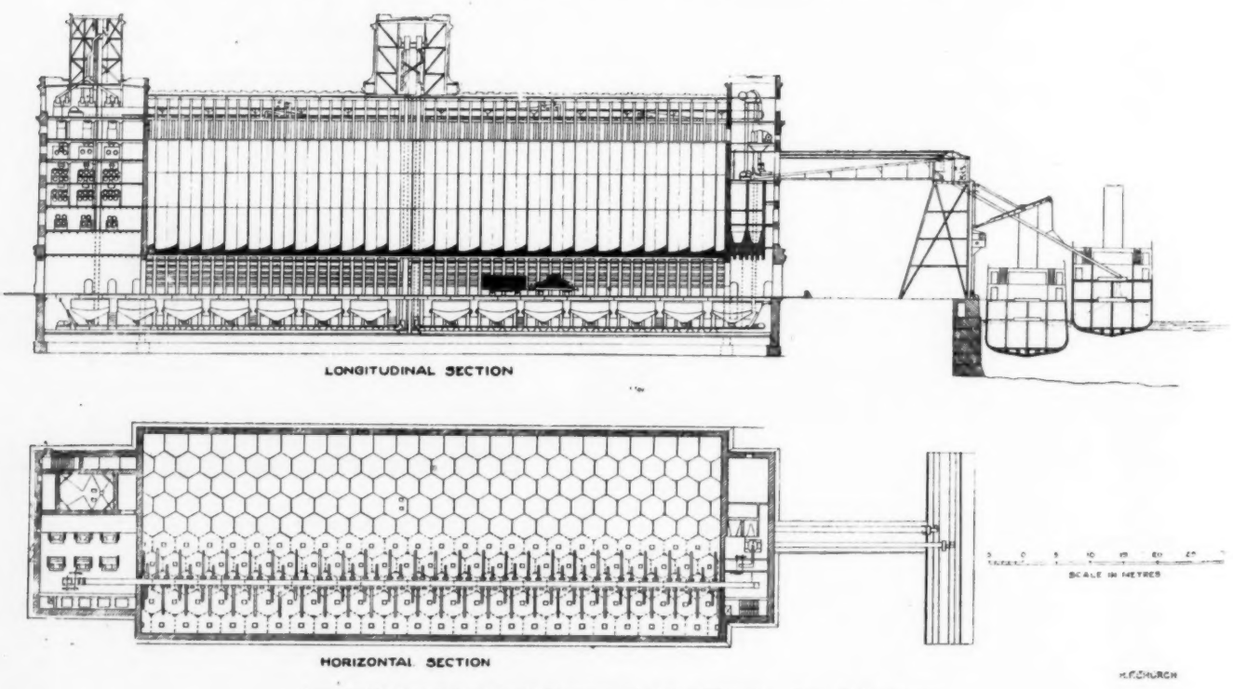
The imports consist largely of general merchandise of every description. Rumania makes its national living from its national products and buys from outside most of its luxuries, except one. This very special luxury, the marvellous caviare, from the sturgeon fisheries at the mouth at the northern branch of the Danube, is the finest caviare in Europe, not excepting the fisheries of the Volga.

The present interest in this study of the foreign commerce statistics of Rumania is the degree to which the War has affected the Rumanian imports and exports and the extent to which the doubling of the area of Rumania after the War has had an effect.

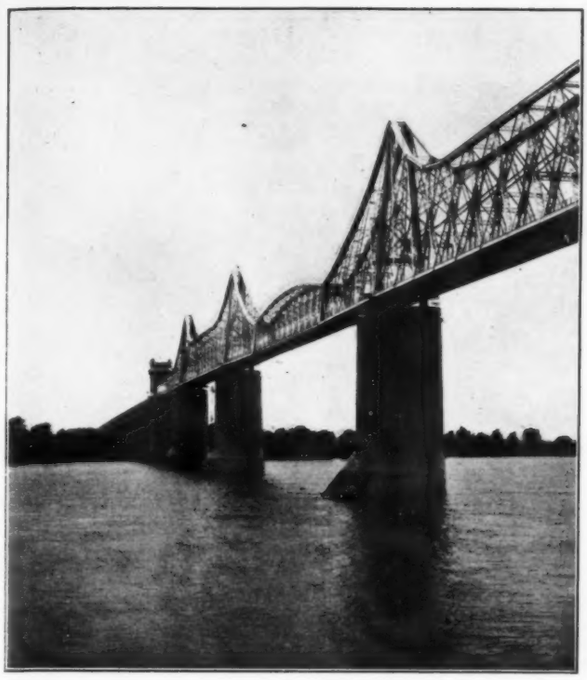
The first consideration is the distribution of the import and export trade among the four principal ports of Giurgiu, Galatz, Braila, and Constanza, on the one hand, and other river ports and railroad transportation on the other.

To Rumania the War was exceedingly impoverishing in the devastation to the country by the contending German and Russian armies that swept from one end to the other on several occasions. It was profitable in a geographical sense, inasmuch as the area of the country was doubled. The principal acquisitions to the territorial boundary were Transsylvania, in the mountains, and Bessarabia along the old Russian frontier. The War destroyed barges and tow-boats on the rivers, port facilities, especially petroleum storage harbours at Constanza and elsewhere. The great bridges were blown up, highways worn out and altogether the destruction was severe even for modern war. The remarkable thing about the doubling of the size of Rumania is the fact that national consumption increased three times. The amount of surplus grain for export, which was the principal source of income of the pre-War Rumania, has been cut down, due to the fact that the Austro-Hungarian mountain people and the old Rumanian stems that were under Russian rule were reclaimed into the Rumanian family, but they had to be fed. Therefore, the exportable surplus was decidedly lower than before the War.

## PORT OF CONSTANZA, GRAIN ELEVATOR.




Longitudinal and Horizontal Sections of Grain Elevator, Port of Constanza.



View of Bridge Carol I.

On the other hand, the mountains of Transsylvania afforded an increased timber supply for the lumber exports. With the great need of lumber throughout Europe to repair the ravages of war, it is obvious that these exports should increase.

## TOTAL FOREIGN COMMERCE OF RUMANIA.

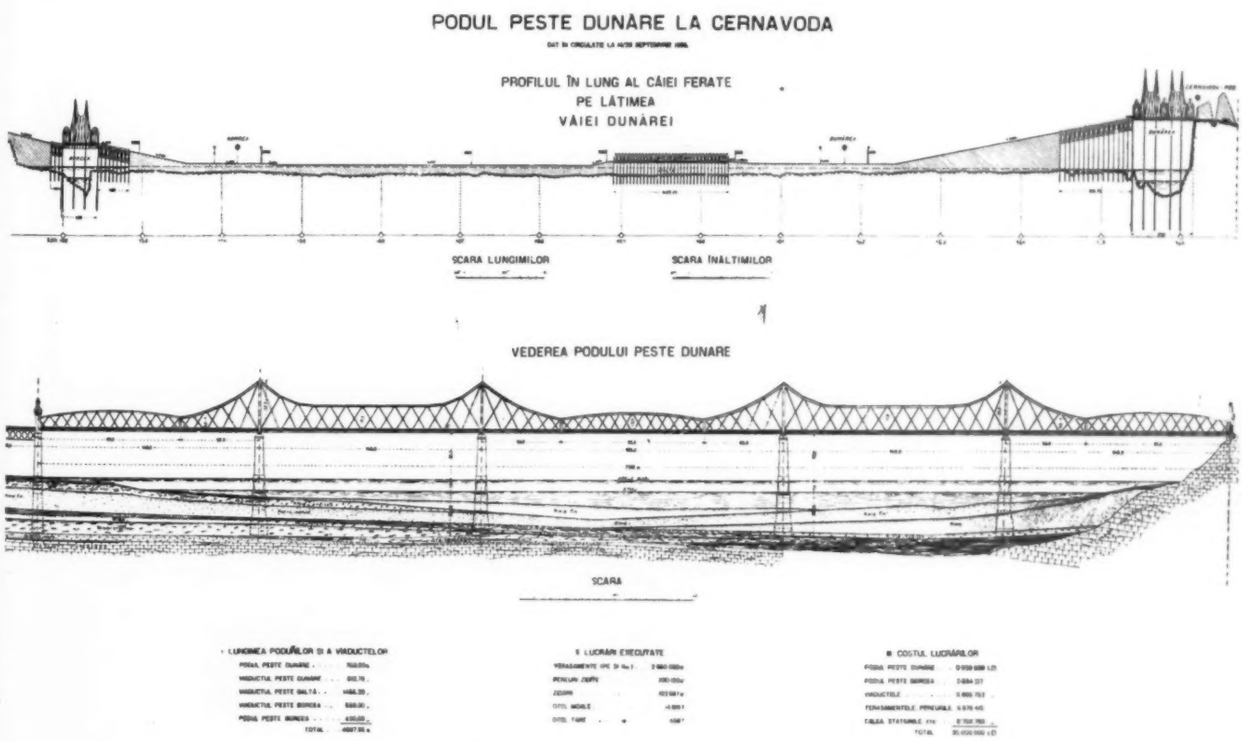
The best year immediately before the War was 1911. It should be noted that the total foreign commerce of Rumania amounted to nearly 6,400,000 tons. Of this, 1,350 tons went through Braila; 1,300,000 tons through Constanza; 850,000 tons through Galatz; and 200,000 tons through Giurgiu. After the War, about 1920, the total foreign commerce had only increased to 1,700,000 tons, as against nearly six million tons in 1913. However, the 1925 figures have risen to 5,600,000 tons, with the four principal ports rising quite rapidly with the general growth in foreign commerce. Braila lagged behind, due not only to the decrease in exportable surplus of grain, but to the labour crisis among the 4,000 cart men and longshoremen at Braila, whose excessive wage demands finished their obsolete methods in the face of modern silo elevators and floating elevators. Galatz almost regained its pre-War statistical totals, thanks to a great increase in lumber exports.

Grain Elevator Quay, showing Loading Legs.

The shoaling of the mouth of the Danube during and just after the War, also had a strong influence in retarding a "return to normalcy."

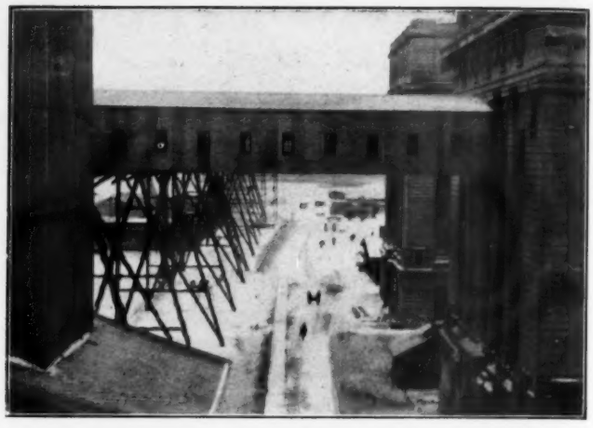
Constanza in 1925 had reached nearly 900,000 tons; in 1926, 1,800,000 tons; Galatz, 850,000 tons; Braila, 600,000 tons; and Giurgiu 300,000 tons, a little better than before the War. By 1925 the total foreign commerce had returned to approximately a similar figure to that of 1912.

Grain exports, associated usually in our minds with Rumania, show an interesting relationship between the exportable surplus before the War and since the War. Before the War, the total agricultural production of grain and corn, amounted to approximately 6,800,000 tons (249,560,000 bushels), of which 3,900,000 tons (143,130,000 bushels) were exported, a little more than half. Greater Rumania, in 1920, produced 9,400,000 tons (344,980,000 bushels), about one-third more, but only exported about 1,000,000 tons (36,700,000 bushels), or one-third as much.




Sections and Plan of Bridge Carol I., Port of Constanza.

Fleet laid up for Winter, Macin Branch.



View of Conveyor Bridge to Ship Side.

By 1923, the exportable surplus had risen to 1,900,000 tons (69,730,000 bushels), while the total production for that year was 9,200,000 tons (337,640,000 bushels). It will be seen that Greater Rumania, although producing considerably more agricultural products than before the War, finds it necessary, due to the increased population, to export considerably less than when the country was only half its present size.

National economy must find other methods of production to meet the purchases abroad or not make any, as has been done for some time in an effort to stabilise the lei that has risen (1926-7) from 220 to 170 lei to the dollar.

The Old Rumania, shaped like a kidney bean, along the valley of the Danube, was one solid level area of black alluvial loam. It was all one great wheat field without a bit of waste. The production per man and the exportable surplus was therefore very high. But along with new territory of poorer agricultural value, there is also the factor of the readjustments in production methods due to the Agrarian reforms. This consisted primarily in breaking up the great estates, and dividing them into small free holdings. Whatever the advantages of this method may be socially, the introduction of small farms compared with the great capitalistic estates using the most modern machinery, means, temporarily at least, till the co-operative societies can supply the expensive machinery, a lower production of large machine units through co-operative effort, this will again be overcome, as it has been in the United States, through the Middle West, where most of the farms are one family units on a quarter section. The largest types of power machinery for ploughing, harvesting, threshing, cleaning, storing, shipping, elevating, and marketing of agricultural products, particularly cereals, is made possible through the co-operation of neighbourhood sections, and the use of gas engine and electric power on the farms.

The most important ports for agricultural and cereal export have been, first, Braila; and before the War, Constanza; and then Galatz, with Giurgiu the river port actually running in a seaport class to which it does not belong, but still sufficiently important, even though only a barge port on a river, to be considered among the four principal ports.

In lumber exports, Galatz that had lost so much in the grain exports, has come to be the principal lumber port of Rumania. Although before the War the lumber traffic of Rumania did not reach half a million tons, yet it has gone to approximately two and one-half million tons in 1924. Of this total, the Port of Galatz, with more than one-half a million tons, now exports more lumber than all of Rumania did before the War.

Petroleum exports have been on a constant increase.

For further emphasis upon the importance of the Danube navigation to the total foreign commerce of the Kingdom of Rumania, it might be noted that in the year 1911, the foreign commerce on the Danube river reached 5,900,000 tons, compared with 4,300,000 on the ocean. In fact, in that year the commerce of Braila was more than 2,600,000 tons on the Danube, by far the most important river shipping point. The next most important river port being its neighbour Galatz, with 550,000 tons of Danube traffic. This should fix in mind that the Port of Braila is the transshipping point between Danube barge and the ocean vessel.

It must be perfectly evident from this investigation that the Kingdom of Rumania is of the greatest importance, not only in the actual tonnage of its commerce, but above all in its strategic position at the mouth of the Danube waterway. Its affairs, its economic and political well-being is without doubt of great importance to all nations and individuals in shipping and foreign trade, because anything that transpires in Rumania affecting its commerce and the commerce of the river will have its effect upon the tonnage and merchandise markets throughout the rest of the world.

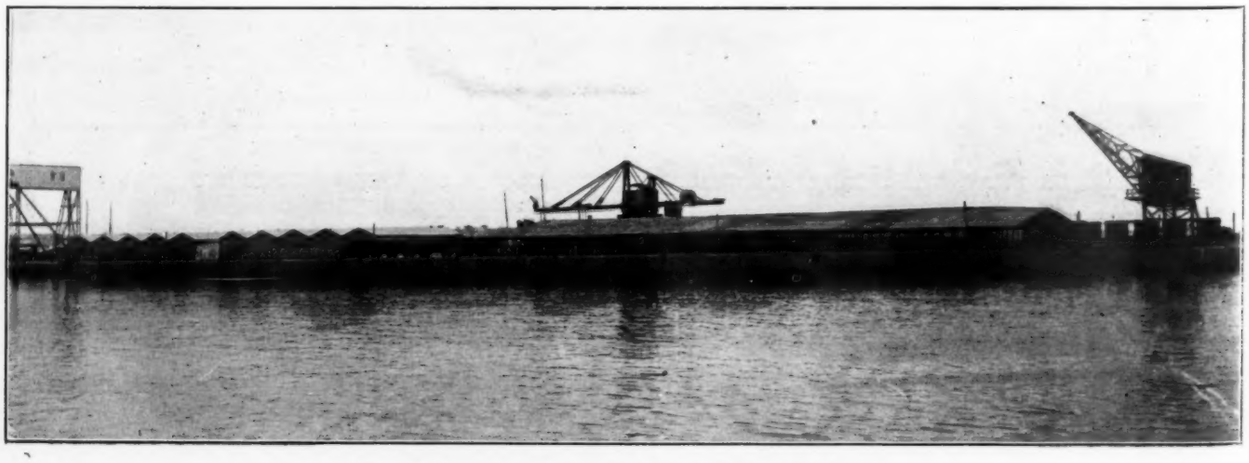
*(To be continued).*

## NEW ORLEANS DEVELOPMENT.

The Orleans Levee Board has contracted with the Harland-Bartholomew organisation to lay out plans for the utilisation of the $15,000,000 reclamation and parking development on the shores of Lake Pontchartrain at New Orleans. The lake-shore project will be variously dedicated to public parks, bath houses, playgrounds, athletic fields, residential sites, etc. It involves the reclaiming of about 2,000 acres of land, within the limits of the city.

## THE WOOLSTON CONTRACT.

The second of the six torpedo boat destroyers being built by Messrs. Thornycroft and Co., at Woolston, for the Chilean Government, was launched at the beginning of March. All six vessels represent the most advanced types of torpedo boat destroyers in construction, sea-keeping, capacity and armament. The contract for them, amounting to approximately 1¾ millions sterling, was given to Thornycrofts after intense competition by British and Continental shipyards, and was one of the biggest naval contracts ever placed in this country by a foreign government for torpedo boat destroyers. The machinery generally is a marked improvement in regard to economy and, consequently, radius of action.



General View of the Cereals Quay at the Port of Constanza.

# The Port of New York.

## *Important New Bridges under Construction. Rail Rates and American Port Competition.*

The annual report of the Port of New York Authority for the calendar year, 1927, constitutes a striking record of the authority's efforts in dealing with vital problems arising in the administration of America's chief port.

It states that the development of projects outlined in the comprehensive plan and other measures looking to the improvement of the port, has been actively prosecuted during the year. Progress has been made in important particulars.

Field surveys have established the fact that a feasible route exists for the New Jersey section of Belt Line No. 1, without prohibitive grades and without grade crossings of the existing rail and passenger lines.

A detailed study of the Raritan River Railroad in connection with the project known as Belt Line No. 10 has determined a normal purchase value for that property.

Studies to indicate desirable locations for air ports within the Port District have been made, and a report published. The investigation continues in co-operation with Federal, State and municipal authorities and other agencies.

An exhaustive investigation of the possibilities of a marine terminal at Perth Amboy was made at the request of the municipal authorities of that city. The staff has co-operated with representatives of Newark, Jersey City, Yongers, Elizabeth and Long Island City, with respect to local marine terminal or channel improvement projects.

Information based upon studies by the staff has been furnished to the United States Army Engineers, with respect to proposals for the deepening of channels and waterways in the interest of navigation.

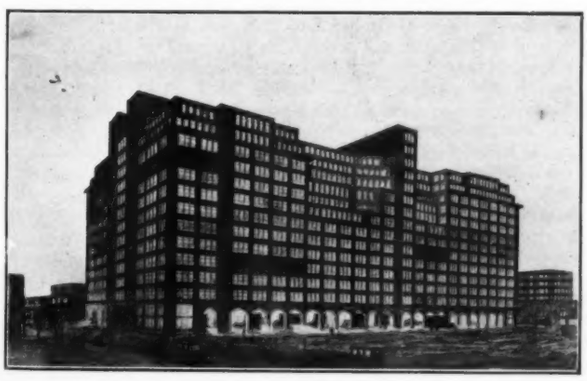
Considerable advance has been made toward the establishment of the first unit in the system of Universal Inland Freight terminals, which are expected to minimize street traffic congestion and largely reduce costs in the handling of freight in Manhattan. Food terminal projects were also progressed, including studies for a union live poultry terminal.

### UNIVERSAL ISLAND FREIGHT STATIONS AT MANHATTAN.

In the latter part of the year the port authority gave formal notice of its intention to establish " a public freight terminal facility on the Island of Manhattan, City of New York," and invited competent individuals and concerns to submit proposals for the lease and operation of this facility.

In this manner announcement was made of the early establishment of the first unit of a series of Universal Freight Stations to be constructed and operated in Manhattan. The comprehensive plan contemplates nine or more such stations, to be so located as best to serve the interests of the shippers and receivers of freight and to facilitate the economic and speedy handling of their goods. Eventually Manhattan will be zoned for freight purposes, and in each zone a Universal Freight Station will permit the manufacturer or merchant to receive all his inbound shipments and to make all his outbound shipments at the same place. The transfer between inland stations and rail terminals in New Jersey or elsewhere will be made by motor equipment and eventually the congested pier stations on the waterfront of Manhattan can be done away with.

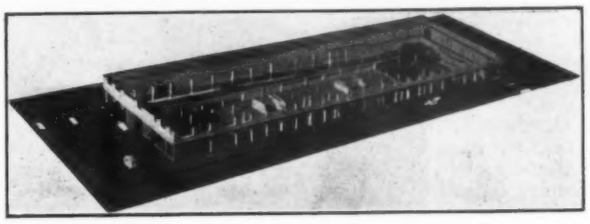
Many of the advantages of the universal stations are apparent at a glance. Staff calculations indicate a direct saving of $12,000,000 annually to the shippers and $2,000,000 to the carriers through their operation, while the indirect savings, though more difficult of calculation will be enormous.



View showing latest design of Union Inland Freight Station.

The site for the first of the Universal Inland Freight Stations was selected on the lower west side of Manhattan, with the assistance of a special " City Sub-Committee On Inland Terminals " appointed at the request of the Port Authority by President McKee of the Board of Aldermen of New York City. The property constituting the site involved was appraised, a suitable structure designed and the construction cost carefully estimated. Abbott Merkt and Company, Industrial Engineers, were retained as consultants in this matter and after a detailed investigation reported favourably upon the design, cost and economical practicability of the terminal. Consultations with representatives of responsible banking houses brought the assurance that the matter of financing the project would encounter no difficulty.

The entire cost of the first unit is estimated at approximately $9,000,000, and the demand from individuals and concerns desiring to lease the upper floors of the building for manufacturing, wholesale or kindred purposes, is far in advance of the space available.



Ground Floor and Basement of Initial Union Freight Terminal.

In the Spring of 1927 President White of the Central Railroad of New Jersey, speaking for the railroad executives at a conference with the Port Authority Commissioners, submitted a memorandum in which, he stated that the carriers " were convinced that the estimates of these Inland Stations would not produce the benefits claimed, either for the public or for the railroads." The staff of the Port Authority prepared a complete analysis of this memorandum, meeting each criticism in detail and this was submitted to President White, with the offer to meet him and the other rail executives in further conferences. The offer has not yet been acted upon, the executives merely replying, through Mr. White, that they did not feel any change in their position justified.

During the year, however, the Pennsylvania Railroad opened two new inland freight stations of its own on Manhattan, and the Lehigh Valley opened a third such station. At present, there are three New Jersey carriers serving Manhattan by motor truck and eight individual inland stations are in actual operation. These stations of the carriers cannot, of course, be compared in point of advantage to the shipping public with those planned by the Port Authority. They handle only the freight transported by a single railroad in each case. They are located in buildings which were designed for other purposes and they are served by narrow streets so that the city sidewalks must be occupied by trucks, creating during certain hours severe traffic congestion. The Port Authority's Inland Station will be provided with ramp driveways, platforms and other features of special design intended to facilitate in every way a speedy and safe handling of freight and the easy movement of vehicles.

The Interstate Commerce Commission has pending an enquiry into the motor trucking practices and off-track station facilities of the New York harbour carriers. The investigation promises to be most comprehensive and may prove to be the basis for orders materially affecting freight handling methods at the port. It will, in our opinion, certainly serve to emphasise the need for union inland freight stations on Manhattan but until the case has been settled there will probably be an indisposition on the part of the carriers to make any further commitments.

### LIVE POULTRY.

As noted in the 1926 annual report, the Live Poultry Commission Merchants' Association requested the Port Authority to advise it in regard to economies of concentrating and re-locating the facilities for receipt, sale and distribution of live poultry in the metropolitan area. The live poultry industry has been in a state of considerable agitation on account of difficulties, not only of physical handling, but with the methods of determining prices and the maintenance of health standards. Both the Attorney-General of the State of New York and the United States Department of Agriculture have become interested in matters relating to the industry. In making studies of physical handling and terminal facilities, the Port Authority maintained close co-operation with these other governmental agencies, and with committees of the trade. As a result of an exhaustive study of the entire terminal situation the staff issued a report on May 5th, 1927, which contains the following conclusions:—

1. A union terminal for the receipt and delivery of live poultry is needed in New York Harbour.
2. Such terminal should be accessible by all trunk lines, at the flat New York rate, and should be their only live poultry terminal (exclusive of private slaughter house sidings).
3. Such terminal should be so located that all trunk lines can give approximately the same service to it (and assure at least fourth morning delivery from Chicago).

4. Such terminal will require about 10.5 acres to provide adequate capacity for following requirements:—
   (a) Spotting 60 cars at unloading platforms.
   (b) Spotting 90 cars on storage and inspection tracks.
   (c) Parking at least 140 five-ton motor trucks.
   (d) Coop storage, cooperage, feed storage, driveways and miscellaneous.

5. Such terminal would result in a saving of at least $50.00 per car, or $500,000 per year, in the terminal distribution of live poultry.

6. The live poultry trade is willing to contribute something towards the expense of providing such terminal facilities.

Since the issue of this report a committee of the trade, with the assistance of the governmental agencies mentioned, has been negotiating for the acquisition of a union terminal accessible to all carriers, and provided with adequate space for economical terminal operation. Negotiations have progressed to the point where a site satisfactory to all parties has been determined upon, and conditions in regard to financing, leasing railroad connections, etc., have been practically settled. Throughout these negotiations the staff has acted in an advisory capacity to the trade, on terminal matters.

On April 1st, 1927, an Act of the New York State Legislature, chartering a poultry exchange for the better conduct of poultry trading, became effective. The charter provides for a membership including representation on the boards of directors of certain public bodies, and individual citizens not connected directly with the poultry industry. One of the bodies specifically mentioned in the law is the Port Authority, which at the invitation of the incorporators designated a representative to act in the administration of the exchange.

The live poultry industry is an important factor in supplying food to a large number of New York consumers. It has become apparent that the improvements in both the physical and commercial handling of this commodity depend in a great measure upon acquisition of adequate terminal facilities. Both from the point of view of assisting in improving food distribution in the port and of applying the principle of establishing union terminals, which is a cardinal principle of the comprehensive plan, the Port Authority is gratified in being able to assist in effecting the improvements that are imminent.

In passing it should be noted that the success of Port Authority activities is not to be measured alone by facilities erected by the Port Authority. In co-operating with private enterprise, the Port Authority, we believe, is actually doing what is contemplated to be done by agency.

## FRUITS AND VEGETABLES.

In another branch of the food distributing industry some progress has been made this year towards securing an agreement on terminal improvements. For a long time the fruit and vegetable industry has been struggling with inadequate facilities. Most of this class of perishables is delivered at pier stations belonging to three trunk line carriers on the North River waterfront. Because of the extremely seasonal nature of the traffic and the individual control of terminals, together with the unsatisfactory design of the existing pier stations for this purpose, high costs and frequent congestion and delay in operations have resulted.

From time to time various projects for new terminals have been advanced by carriers, receivers and public officials. Thus far no comprehensive plan for such improvement has been agreed upon. A proposed transfer of delivery to a terminal in Jersey City on the part of the Erie Railroad has resulted in crystallising among New York shippers and receivers the sentiment for a union waterfront facility on Manhattan Island.

As a result of negotiations between the trade interests and the Pennsylvania Railroad, the existing facilities of that carrier, both on the North River waterfront of Manhattan, and in the supporting yards in New Jersey, have been considerably enlarged and re-designed to accommodate more of this traffic. The division of the western fruit traffic between the two competing carriers, the Erie and the Pennsylvania, still remains a matter of controversy, to the extent that the only apparent solution is the consolidation of waterfront facilities, so that they may be available to both and to all other trunk lines.

The staff has made extensive investigations into the feasibility of union fruit and vegetable terminal facilities, and the details of operation and design. In these investigations it has had the assistance of the United States Department of Agriculture. During this year a closer understanding in regard to this matter was established with officials of the City of New York by the appointment of a sub-committee representing numerous departments of the City and the Port Authority Staff to report on the feasibility of union facilities. This committee has reached an agreement on the essential features of such an improvement, and has submitted a report recommending:—

1. That the kind of terminal most immediately practical and most needed at the present moment is a single primary terminal rather than a number of decentralised borough terminals.

2. That this terminal should be a union terminal open to all common carriers, and capable of being operated as a unit rather than simply a group of separate piers controlled by individual carriers.

3. That this terminal should be located on the Manhattan North River waterfront, occupying approximately 1,000 ft. on the waterfront somewhere between Piers No. 20 and No. 30.

The Mayor of New York City has been requested to appoint an enlarged committee, consisting of the public authorities, the carriers, shippers and members of the local trade, for the purpose of working out a practical solution which will satisfy the desire for a fruit and vegetable terminal open to all carriers and designed for economical operation.

## FOOD HANDLING RESEARCH.

To foster improvements in some of the wider aspects of food distribution the Port Authority has continued its co-operation with the United States Department of Agriculture and six other public and educational institutions in maintaining headquarters and staff of the New York Food Marketing Research Council. The principal aim of this Council is to promote and co-ordinate intensive studies of the various phases of the marketing problem in the Port of New York District, and to disseminate this information through periodic conferences with shippers, carriers, dealers and public officials.

A number of studies were carried forward last year by various members of the Council, some being printed for public distribution and others advanced to the stage of preliminary manuscripts. In addition to the report on a union terminal for the live poultry trade, hitherto mentioned as a Port Authority report, there has been released by the United States Department of Agriculture a preliminary survey of the prices, costs and commercial practices of the live poultry trade. The other studies which have progressed to manuscript form have to do with dairy terminal requirements and market analysis of apples, peaches and eggs.

As a means of carrying to the trade and public officials the results of the research work now in progress, three public conferences or meetings were held, at which the following subjects were discussed:—

Wholesale and Retail Costs of Handling Fresh Fruits and Vegetables in Metropolitan New York.

Trade Mark Standardisation in the Marketing of Perishable Food Products.

Apple Market.

These meetings were well attended, and served as a very effective medium for stressing the practical application of the information developed through the various studies. By circulating a record of the discussion of these meetings an even wider influence was exercised.

The Executive Secretary of the Marketing Council also served as co-ordinator for the joint activities of the live poultry commission, merchants, shippers and buyers, and the public agencies in negotiations over terminals, methods of trading and grades. Approximately fifteen special conferences were arranged and summaries of the proceedings cleared through the Council headquarters.

## BELT LINES.

The system of belt lines embraced within the comprehensive plan was designed to co-ordinate the terminals of all the railroads serving the port district. Its effectuation will make the lines of all carriers more readily accessible to shippers and receivers throughout the port district. The system of belt lines forms a base upon which all port improvements must be predicated.

## BELT LINE No. 1.

In order to ascertain whether this belt line could be constructed in the New Jersey territory indicated on the comprehensive plan, without involving grades too heavy to be feasible, or other serious obstacles, a field survey was made of the proposed middle section lying between County Road (Croxton), and Newark Avenue (Marions), Jersey City. This study developed the fact that a line with " non-prohibitive " grades could be constructed which also would not have grade crossings with any of the intersecting railroads.

A map of the territory was prepared and the proposed centre line of Belt Line No. 1 was shown. A profile of this section was also prepared, and the proposed gradients shown.

The section north of the County Road (Croxton), offers no physical difficulties. A general plan was prepared from maps furnished by contiguous carriers. A map of the southern section, along the Bayonne Peninsula, was prepared from data furnished by carriers.

The municipal authorities of Jersey City, the Pennsylvania Railroad, and New Jersey State Highway Department, undertook studies for an under-crossing of the P.R.R. tracks in the vicinity of Wallis Street and Charlotte Street, Jersey City. This will be used in connection with the New Jersey State Express Highway (Extension of Route No. 1) which will pass over the tracks of the Pennsylvania Railroad in this vicinity. The proposed centre line of Belt Line No. 1 is adjacent to the Express Highway, and is so located that it does not conflict with it, or with the proposed under-crossing.

That portion of Belt Line No. 1 along the north shore of Staten Island, comprehending the existing Staten Island Rapid Transit route, as indicated on the comprehensive plan, has received particular study, owing to the fact that the Transit Commission of New York (Metropolitan Division) has been

conducting hearings on the elimination of all grade crossings from West New Brighton to Arlington.

Recommendations were made to the Transit Commission proposing a plan for the elimination of dangerous grade crossings, and at the same time the preservation of the industrial interests of the neighbourhood.

BELT LINE No. 13.

During the year the port authority staff continuously followed rail operations on this belt line, which is located adjacent to the New Jersey waterfront of the Hudson River, maintaining contacts with the industrial plant managers and others, to the end that good service might be afforded. The railroad executives in consummation of an undertaking previously agreed upon appointed Mr. J. E. Davenport, Division Superintendent of the West Shore Railroad, as Director of Operations, Belt Line No. 13, effective March 1st, 1927, thereby providing a medium through which co-ordinated service could be secured by shippers. " Belt Line 13 " is now listed in the local telephone directory, so that the Director of Operations may be quickly reached by the shipping public in the territory served.

HOBOKEN SHORE ROAD.

In the Summer of 1927 the War Department concluded an agreement for the sale of stock of the Hoboken Manufacturers' Railroad, operating what is known as the Hoboken Shore Road, and the waterfront property attached thereto for a total of $937,657.00. The purchasers were private interests. The operation of the properties was given over to the new interests on July 1st and title was transferred October 1st, 1927. A bond issue of $1,250,000 was floated by the new company in order to effect the purchase and also to provide capital for operation purposes.

The Port Authority had sought for a long time to have the Hoboken Shore Road and the waterfront property retained in public hands and itself undertook to effect purchase under a law passed by Congress to permit of this. It also stood ready to co-operate in the purchase by the City of Hoboken or some other public body. Its offer of $1,000,000 in Port Authority bonds for railroad and waterfront property was thought to be acceptable to the War Department. At the last moment, however, the negotiations fell through because of the imposition of conditions by the War Department which the Commissioners felt were not in the public interest. Representatives of the new owners have advised the Port Authority that the Hoboken Shore Road will be operated in close co-ordination with the services given by the other carriers of Belt Line No. 13, of which it is made an integral part under the comprehensive plan. Thus assurance is given that the main object of the comprehensive plan will be achieved.

During the year the Hoboken Shore Road petitioned the Interstate Commerce Commission for an increase of its allowance for the handling of raw silk, which furnishes a large amount of the tonnage of this line. In the preparation of the case, the Port Authority staff gave assistance. The ruling of the Commerce Commission increased the allowance to such an extent that it is estimated the company will probably gain approximately $50,000 a year in its revenues.

The allowances to this line for handling general merchandise have also been increased as a result of negotiations with its trunk line connections.

BELT LINE No. 10.

An inner belt line from New Brunswick to South Amboy approximating the general direction of the Raritan River Railroad, is designated on the comprehensive plan as Belt Line No. 10.

The staff has made an office study and detailed compilation of the operating characteristics of the Raritan River Railroad, for the purpose of determining what would be a normal purchase value in case the property were placed upon the market.

BROOKLYN-NEW JERSEY FERRY.

The proposed Brooklyn-New Jersey Ferry has not yet been brought into being. Ferry slips are available on the New Jersey side, but on the Brooklyn shore the leasing of available slips is vested in the City of New York. On January 8th, 1927, application was made to the Commissioner of Plant and Structures for a franchise to use a ferry slip at the foot of Atlantic Avenue, Brooklyn, belonging to the City of New York. Applications have been presented by a number of interested concerns, but so far no award has been made. The proposed service is a necessary one and will materially relieve street congestion in lower Manhattan.

PERTH AMBOY MARINE TERMINAL FACILITIES.

The staff, during the year, at the request of the Commissioners of the City of Perth Amboy, conducted an investigation and study of possible locations for a marine terminal within the corporate limits of Perth Amboy. An engineering report was prepared and submitted, in which were enumerated possible locations for such a terminal, together with approximate estimates of cost of construction.

The report was prepared as a basis for a traffic survey which the municipal authorities purpose to make in order to ascertain the financial feasibility of the project, either in part or in its entirety.

LOCAL MARINE TERMINALS.

The engineering staff during the year has had conferences with representatives of Newark, Jersey City, Yonkers, Elizabeth and Long Island City regarding their local marine terminal or channel improvement projects.

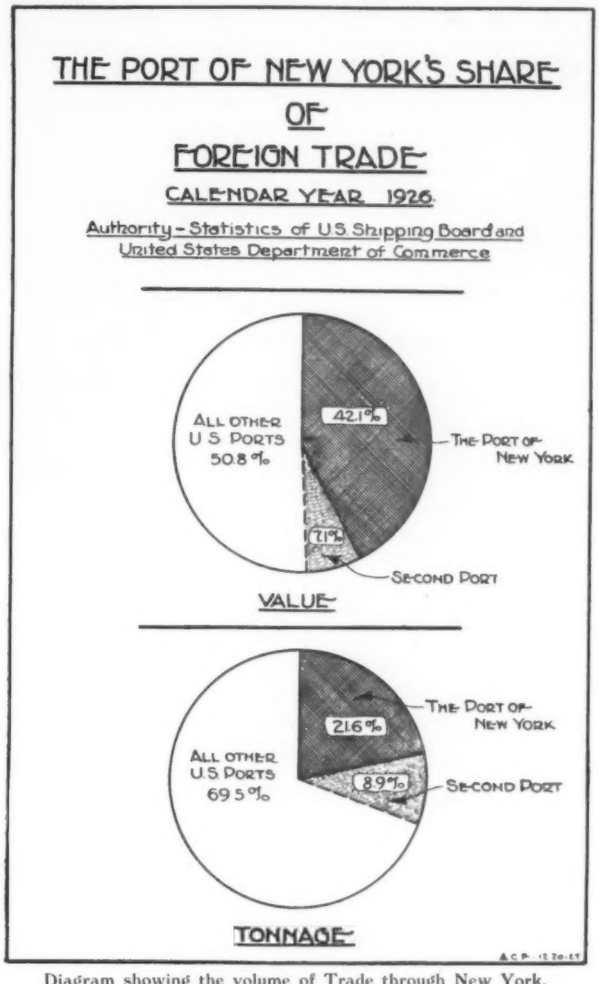



Diagram showing the volume of Trade through New York, compared with other U.S. Ports.

CHANNEL IMPROVEMENTS.

The opinion of the Port Authority was invited by the United States Army Engineers in connection with the various " channel improvements " and " pierhead line modifications " projects. Accordingly the staff of the Port Authority investigated and rendered reports upon the following :—

The Raritan and South River Channel Improvement.

Establishment of 20 ft. deep Channel, 200 ft. Channelward from the Brooklyn Shore, between Englis Place and Pierce Avenue, Long Island City.

Modification of Pierhead Line between C.R.R. of N.J. Ferry and Essex Street, Jersey City.

Modification of Pierhead Line between West 30th Street and West 72nd Street, Manhattan.

Hudson River " shore to shore " 40 ft. deep Channel, Battery to West 20th Street.

Passaic River 30 ft. deep Channel from Port Newark Terminal to Jackson Street Bridge, Newark.

On each of the above projects the staff made investigations as to the economic merits, and communicated its conclusions to the United States District Engineers. In a majority of cases the proposed improvements were favoured. In the other cases the recommendations looked to deferring work until the development of commerce justified the necessary expenditures.

CARFLOAT AND LIGHTERAGE SERVICE.

It is gratifying to report that the staff studies of the economies to be obtained through co-ordinated effort of the marine departments of the various railroads are beginning to bear fruit. During the year the carriers have taken a step towards central dispatching by installing special telephone facilities directly connecting the tug dispatchers of the several railroads so that they can exchange information and perform towing service for each other when opportunity arises. Since this arrangement was put into effect a substantial amount of the towing formerly contracted for by the carriers has been performed by railroads themselves, thus serving to reduce to that extent the aggregate railroad terminal expense at the port. Meanwhile the staff is pursuing its economic analyses of this

entire matter with the object of perfecting a plan for even greater co-ordinated effort which will be acceptable to the carriers. The savings thus far effected constitute only a minor portion of the potential economies possible to the carrier through unified effort.

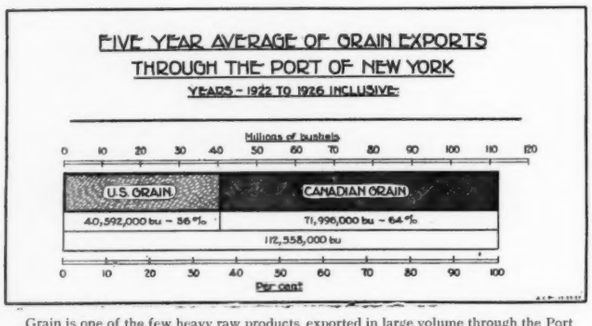
## AIR PORTS.

The matter of a suitable air port for the Port of New York District has received considerable attention during the past year. An air port is primarily a terminal facility for aircraft, and as such the Port Authority is interested in having provided the best facilities possible.

In the early part of 1927 a preliminary report was prepared by the staff setting forth the general and primary equipment required, the accessibility of the location in respect to highways, railroad, etc., the manner in which it could be established, the general characteristics, the traffic, the importance of commercial aviation and responsibility for an air port, list of existing air ports in the United States, existing landing fields in the Metropolitan District, and notes in regard to the construction of an air port.

Later, Secretary of Commerce Hoover appointed a Fact Finding Committee to investigate and report on a New York Metropolitan Airport, Asst. Secretary William P. MacCracken, Jr., was selected as chairman and sub-committees were appointed on location, engineering, ways and means, and valuation. The Port Authority was represented on the sub-committee on engineering.

The Fact Finding Committee reported on December 20th, 1927, recommending a system or series of airports throughout the district to be developed as needed. Six sites were suggested as suitable for initial development, four in New York City and two in the New Jersey sector of the port. The committee also recommended development of local airport facilities by one or other of the two states, or by one of the political sub-divisions thereof rather than a bi-state development. Various local committees are now actively advancing the committee's recommendations.


FIVE YEAR AVERAGE OF GRAIN EXPORTS
THROUGH THE PORT OF NEW YORK
YEARS - 1922 TO 1926 INCLUSIVE:
Millions of bushels
0 10 20 30 40 50 60 70 80 90 100 110 120
U.S. GRAIN
CANADIAN GRAIN
40,592,000 bu - 36 %
71,996,000 bu - 64 %
112,558,000 bu
0 10 20 30 40 50 60 70 80 90 100
Per cent

Grain is one of the few heavy raw products exported in large volume through the Port of New York. In recent years most of the Grain Exports have been of Canadian Origin, moving from the Great Lakes to New York for shipments in parcel lots to many foreign ports.

## WEST SIDE IMPROVEMENT.

A report from the so-called " West Side Improvement Engineering Committee," appointed by Mayor Walker, of New York, to consider the New York Central's plan for the improvement of the west side of Manhattan Island was presented in the early summer. The committee consisted of William C. Lancaster, Chief Engineer, Transit Commission; Arthur S. Tuttle, Chief Engineer, Board of Estimate and Apportionment; G. W. Kittredge, Chief Engineer, New York Central Railroad; C. M. Pinckney, Chief Engineer, Borough of Manhattan; Robert Ridgway, Chief Engineer, Board of Transportation; Billings Wilson, Deputy Manager, Port of New York Authority.

This body functioned continuously from the date of its appointment until a physical plan was decided upon which would eliminate all grade crossings on Manhattan Island, relocate and reconstruct the yards at Manhattanville, 60th Street and 30th Street, and also erect a multi-storey building which would constitute a southern terminal and be known as " Spring Street Terminal."

The Port Authority's plan for handling freight by means of " off track " Universal Inland Freight Terminals, operated as both receiving and delivering stations for all carriers was presented to the committee and in consequence the ground floor of the " Spring Street Terminal " has been so arranged that it can be operated as a universal freight station when necessary.

In all of the deliberations of the Engineering Committee discussion was narrowed down to the physical aspects of the plan. Recommendations upon economic features, or the features of Manhattan freight distribution in general were barred from consideration.

The report was transmitted by the Mayor to the Board of Estimate and Apportionment which gave a public hearing on the subject on June 16th, 1927, and appointed a committee consisting of President Joseph V. McKee, of the Board of Aldermen and President Julius Miller, of the Borough of Manhattan to give consideration to the matter. Shortly thereafter the Port Authority transmitted a letter to this committee calling attention to the fact that the report dealt with physical questions alone and that the economic aspects of the situation should be considered before final decision. The committee of the Board of Estimate has not as yet presented its findings to that Board, nor has it as yet conferred with the Port Authority on the economic or other features of the plan.

## JOINT BRIDGE OVER NEWARK BAY.

The Lehigh Valley and the New York Bay Railroad (P.R.R. lessee) made application to the War Department and the New Jersey Board of Commerce and Navigation for permission to replace their swing bridge and its approaches over Newark Bay, which has outlived its usefulness with a modern type vertical lift span and girder approaches.

The railroads modified their original petition by the insertion of stipulations calling for the complete removal of the existing structure and amending the time for construction and placing in service of the new structure.

The application as amended received the approval of the Port Authority. The report of the district engineer was favourable. Work on approaches has started.

## HACKENSACK RIVER CROSSING.

The New Jersey State Highway Commission and the Pennsylvania Railroad made application to the New Jersey Board of Commerce and Navigation for a permit to construct modern type lift spans with girder approaches, over the Hackensack River, in the vicinity of Newark Avenue, Jersey City. This application was made so as to carry out the requirements of the War Department in this matter. The Port Authority forwarded its favourable recommendations to the New Jersey Board of Commerce and Navigation.

## PROTECTION OF THE PORT.

The recent revival of competitive rivalry between ports, for foreign trade, has emphasised the necessity for taking stock of New York's position as a port. Important statistical information regarding export, import and inter-coastal traffic is periodically collected and released by such government agencies as the United States Shipping Board, United States Department of Commerce and the United States Army Engineers, as well as numerous commercial organisations. The staff of the Port Authority has given considerable time to the analysis of these records to determine which types of trade are increasing through the Port of New York. As time permits, these studies are being extended to discover the degree to which distance, steamship service, commercial practices and port facilities may be responsible for the trend of growth or decline. Not only in developing physical facilities, but also in defending the port against unwise and harmful attacks before the Interstate Commerce Commission and the United States Shipping Board, the value of the work has been recognised.

There is an erroneous impression prevalent among interests located at other ports that New York is handling too much business for its own good, and the good of the country, and that steps should be taken to draw some of this traffic away by establishing railroad freight differentials in favour of other ports, or operating steamship lines on a subsidy basis to stimulate traffic. One of the witnesses for the Port of Baltimore in the recent hearing in I. C. C. Docket 18715 stated: " We believe also, in Baltimore that there is a great national question involved in this proceeding, in that the centralisation of export business at New York is bound to result in the driving out of all of the other ports." Accurate information on these subjects will perhaps minimise much fruitless controversy and prevent arbitrary diversions of traffic which may disrupt well-established channels of trade and impede foreign commerce.

New York's present position as the premier port of the United States, handling approximately one-half of the total foreign trade, is due in large part to the steamship service which has grown up as a result of the excellent harbour, large passenger traffic, immense local industrial and commercial development, and spendid banking and brokerage facilities. Comparison of the steamship sailings in overseas trade indicates clearly the supremacy of New York in this regard. Fast and frequent sailings encourage the movement of commodities of high value, for which minimum interest charges and prompt deliveries are essential. Comparison of the relative growth of selected high and low value commodity groups indicates that it is the former class that is swelling the export and import trade through the Port of New York.

For such commodities as grain, around which some of the most intense competition revolves, New York has peculiar geographical advantages in its relation to the Great Lakes, and its connection with Buffalo via the Barge Canal. New York is a peculiarly attractive port for export Canadian grain, and study of the figures for the last two decades reveals that it is Canadian grain " in bond " which has increased the export total at New York, while the domestic grain raised in the United States has been flowing through the outports, including Montreal, in increasing degree.

The compilation, analysis and interpretation of statistical records has not been confined to foreign trade and shipping. On domestic traffic for local consumption, manufacture and trade, similar analyses of the growth and distribution over a period of years have been made and correlated with studies of

population and industrial migration within the Port District. Valuable facts upon which to base conclusions as to the economic practicability and the most satisfactory location of various terminal projects in the port district are being and must be developed in this way. This type of continuous planning and research is carried on by the statistical division in addition to the investigations of specific engineering projects embodied in the staff programme.

## ACTIONS BEFORE RATE TRIBUNALS.

The necessity for combating unfriendly proceedings, generally in the nature of proposals for increased freight differentials against the Port of New York, continues as a vital part of the Port Authority work. It has been necessary to intervene in many proceedings brought before the Interstate Commerce Commission, or other rate regulating tribunals, which would have the effect, if carried to a successful conclusion, of dealing severe blows to the commerce of this port. Sometimes these proceedings have taken the form of direct requests for increased differentials in the railroad rates. Sometimes they have been disguised, intentionally or otherwise, but on the surface, at least present an innocent appearance. Nevertheless, upon analysis, they prove to be adverse in their ultimate effects and must be resisted vigorously.

Certain of the Atlantic ports to the south of New York have been active in recent years in the endeavour to secure more favourable railroad freight rates. A new turn was given to the situation in the last year by a demand made upon the United States Shipping Board for ocean differentials based upon the distances between American Atlantic ports and ports in foreign countries. The effect of this latter action, if successful, cannot be accurately estimated at the present time, but it requires as it does in all other proceedings, the presentation of the case of the Port of New York in such manner that its interests shall not be jeopardised.

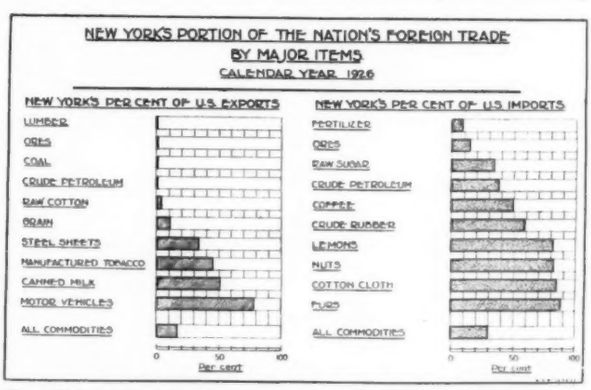
Succeeding sections of this report will give the status of proceedings which have been brought from time to time before the Interstate Commerce Commission and other tribunals.

## ATTEMPTED DIVERSION OF TRAFFIC TO GULF AND SOUTH ATLANTIC PORTS.

A new instance of the continued pressure upon the Interstate Commerce Commission to permit radical cutting of rail rates for the purpose of diverting foreign commerce from the Port of New York is evinced by a proceeding, now in progress, known as Fourth Section Application 2040, et al.

At the first hearing, held in Chicago, December 6th, 1927, the railroad lines serving Gulf and South Atlantic ports applied for permission to depart from the provision of the Interstate Commerce Commission Act which prohibits lower charges for longer than for short hauls. The gulf carriers have proposed rates on import and export traffic to the territory north of the Ohio River and west of Chicago and Indianapolis which are in some instances only half as high as the rates to intermediate points south of the Ohio River. They justify these exceptionally low rates into this territory on the ground of competition by the carriers serving the North Atlantic ports.

At the Chicago hearing voluminous exhibits and testimony were introduced to show that the North Atlantic ports enjoyed superior steamship service, shorter distances to European ports and the advantages of highly developed local industrial and commercial communities. As usual the principal attack was upon the position of New York as the leading port for the export and import of commodities originating in competitive territory.




**Raw Materials produced in Outlying Areas are often shipped through Outports more accessible than New York, but the location of heavy Industries within the Metropolitan Area stimulates heavy Imports of Raw Materials through the Port.**

The relationship of rates on import and export traffic between Central Freight Association territory and New York, on the one hand, and Central Freight Association territory and New Orleans, on the other, has been the subject of a long-standing controversy. As far back as 1907 two arbitrators, appointed by the opposing carrier-groups, recommended the establishment of a differential, New Orleans under New York, on import rates from Europe and Africa only, ranging from 18 cents first class down to 6 cents sixth class. For some years this recommendation, known as the Todd-Knott Award, was the principal basis of rate adjustment. During the war-time percentage rate increases, however, the differential in favour of the gulf was considerably widened and extended to export commodities and to more territory than first contemplated.

At the time of the award, ocean rates were considerably higher to the Gulf than to North Atlantic ports. This condition has been changed so that on the more important commodities the ocean rates to-day are the same. Nevertheless, the railroads operating to the Gulf are now asking the Commission to permit them still further to increase the differentials under New York up to a maximum differential of 44½ cents per 100 pounds on imports to Louisville, Kentucky, and 65½ cents per 100 pounds on exports from Cairo, Illinois. The carriers serving the South Atlantic ports have asked permission for a similar cut in their rates to and from differential territory running to a maximum differential to Louisville on import traffic the same as the Gulf, but not quite so high a maximum differential on exports; the Cairo differential on exports amounting to 46½ cents first class.

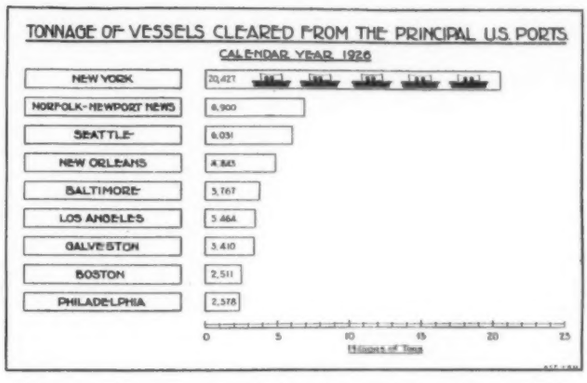



**Diagram shows Tonnage of Vessels cleared from the principal U.S. Ports during 1926.**

The staff and counsel of the Port Authority have intervened in these proceedings and, working in co-operation with representatives of the other North Atlantic ports and with the trunk line carriers, will oppose the granting of lower rates requested by the Gulf lines on account of their manifest unfairness to the North Atlantic ports.

Further hearings will be held in 1928 at Savannah, at New Orleans and at Washington, D.C., the latter on February 14th. At the Washington hearing the North Atlantic ports will put in their case in opposition to the increased differentials.

## BALTIMORE PORT CASE.

Directly connected with the attempts made by competitive ports to secure a segregation of terminal charges, in so far as they relate to floatage and lighterage delivery, is a case before the Interstate Commerce Commission (Baltimore Chamber of Commerce v. Ann Arbor Railroad Company, et al.). In this Baltimore commercial interests complain that the carriers are giving undue preference to the Port of New York by absorbing excessive terminal costs.

The complaint alleges that the present differential of 3 cents per 100 pounds on import and export traffic (1½ cents on grain) which is enjoyed by Baltimore under New York, does not reflect the true difference in moving freight from points west of Buffalo and Pittsburgh to and from shipside. A doubling of this differential (quadrupling for grain) is requested, together with separate publication of terminal charges for lighterage movement which shall reflect alleged differences in cost of harbour service. This is another phase in the longstanding controversy between the various North Atlantic ports in regard to the adjustment of rates moving foreign commerce.

Hearings from the Commission in this complaint were held from September 20th to September 29th, at Washington. The evidence presented by our staff and others was decidedly unfavourable to Baltimore's contention, showing, among other things that at Baltimore almost as much tonnage must be lightered or switched to and from shipside as is handled directly between railroad piers and ship's tackle. The contention that terminal costs in handling grain are excessive in New York was also exploded by evidence that due to the heavy investment in elevators, the average cost per ton at Baltimore was $1.83 as against $1.26 at New York. The claim that the existing differential adjustment had injured Baltimore commercial interests by depriving them of traffic, received little support from the figures introduced which showed substantial relative gains in Baltimore's foreign trade, particularly imported commodities, during recent years.

The Port Authority, together with other New York interests, took an active part in opposing the Baltimore proposals to widen the existing differentials and separate terminal charges. Such action would revolutionise rate making, and might result in widespread and disastrous changes in the organisation of facilities and physical and commercial handling of foreign trade.

The case is closed, and report of the Commission is awaited.

OPPOSITION TO RESTRICTIONS ON FREE LIGHTERAGE SERVICE.

From time to time various attempts are being made to restrict the terminal service performed by the railroads and coastwise steamship companies in connection with harbour delivery under through rates at the Port of New York. On lumber, for example, there has been a persistent effort to impose a charge for terminal handling. The most recent proposal is the imposition of a 50 cents per ton charge for handling lumber at the North Atlantic ports. This matter has been the subject of several conferences between the lumber interests and commercial trade associations and railroad representatives, and further conferences are scheduled before the carriers take final action in this matter. The Port Authority is participating in these conferences and discouraging the imposition of separate terminal charges.

Another increase in the charges for harbour lighterage service was proposed in connection with the handling of heavy freight in New York Harbour by floating derricks. Although the railroads have a number of craft equipped with these derricks, it has been the practice of the carriers to employ outside lighterage companies in many instances, making an allowance of from 60 cents per ton for pieces weighing not more than 3 tons up to $2.36 per ton for pieces weighing 35 tons. In all cases the railroads have absorbed 60 cents of this allowance, making extra charges to the shipper for the excess above this amount. One of these outside lighterage companies proposed to increase the charge for performing this service on the ground that no readjustment had been made for 40 years, although the costs of operation had increased materially.

The Port Authority was represented at the hearings on the proposal, and in co-operation with the commercial associations, successfully opposed the attempt to pass this charge on to the shipper on the ground that the increases in freight rates should permit the absorption of any fair readjustment in the heavy lift service allowances. The proposal was removed from the carriers docket and the matter temporarily closed.

PORT CHARGES INVESTIGATION, I. C. C. DOCKET No. 12681.

More sweeping than any of these individual items is the attempt on the part of representatives of various outports, competing with New York, to have the Interstate Commerce Commission segregate all cost items relating to terminal delivery by carfloat and lighter into a separate charge, to be based upon the cost of such service. This issue has emerged into proceedings before the Interstate Commerce Commission, in the Baltimore Port Differential Case, supra, and in Port Charges Investigation, Docket 12681.

This latter proceeding, which grew out of specific complaints by The American Warehousemen's Association and various private warehouses and municipalities, particularly in southern ports, against the practice of the railroads of absorbing in whole or in part the cost of accessorial services, such as warehousing, wharfage and steamship dockage, has taken on a particular significance to the exporters, steamship companies and other interests using the Port of New York. In the extension of this investigation to the North Atlantic ports, the United States Shipping Board expressed a special interest in the proceedings, and was responsible for a questionnaire being submitted to the carriers asking for detailed statement of the costs of operating rail-water terminals at the various North Atlantic ports, excluding switching, but including lighterage costs. The replies to these questionnaires, as filed by the carriers, and the testimony thereon, were extensively considered at hearings held in Washington, Boston, New York and Philadelphia during the year.

It became evident that the Counsel for the United States Shipping Board, and representatives of the Ports of Baltimore and Philadelphia, in particular, were advocating the separation of terminal charges from the line haul portion of the freight rate, not only for the accessorial services of dockage, storage, etc., but also for harbour lighterage. It is apparent that the attempt to segregate the charge for lighterage service is aimed at increasing the aggregate transportation rates through the Port of New York, where, due to the geographical situation, the bulk of the import and export traffic must be moved across the waters of the Hudson River or Lower Bay. In the hearings an attempt was made to distinguish marine lighterage service from ordinary delivery service, although the Commission has held in Lighterage and Storage Regulations at New York, 35 I. C. C. 47, that " terminal floating service at New York, having been adopted by the railroad companies many years ago as the natural and necessary recognition of the physical conditions, is now to be considered as much a part of the transportation service of the carriers as the service rendered on their rails."

At the various hearings to date the Port Authority has been represented by staff and counsel, and has opposed the attempt to divorce lighterage from the line haul service obligations of the carriers under the existing system of through rates, although taking no position in the matter of segregation of true accessorial services, such as dockage, storage, etc.

The proceedings so far have not considered the expensive terminal switching costs at other ports, but have included lighterage costs at New York despite the general admission that lighterage is only a substitute or alternative for switching. We have taken exception to this feature of the enquiry as it creates an erroneous picture of what purports to be comparative port costs.

Further hearings in this case will be held at the South Atlantic and Gulf Ports.

MAYBROOK ROUTE CASE.

The Maybrook route case (noted in the annual reports for the years 1925 and 1926), which was brought by the Central Railroad of New Jersey against the New York, New Haven and Hartford Railroad, to remove discrimination in the interchange of freight through the New York gateway, was decided February 8th, 1927, by the Interstate Commerce Commission. The decision sustains the Port Authority's contention that additional traffic, alien to the Port District, should not be moved through New York Harbour terminals, where the available capacity is required for local needs. Therefore, in ordering the New Haven to remove discrimination against the Central Railroad of New Jersey in making joint rates, the Commission ordered that territorial rate lines be drawn so as to maintain the relative use of the New York Harbour route as contrasted with the Maybrook route, the same in the future as it is now.

No specific order was entered against the New Haven Railroad, but instead, 90 days was allowed for working out a suitable agreement. Nothing resulted, and the New Haven Railroad, in the meantime, petitioned for a re-argument of the case, which was held on October 14th. The Port Authority re-affirmed its position at this hearing. Formal decision is awaited.

*(To be continued).*

## French Harbour Affairs.

PETROL IMPORTS.

The French Chamber has passed the Bill regulating the import of petroleum into France. All imports of over 300 metric tons a month are placed under special regulation. Foreign and French firms rank on the same footing in this respect.

NEW FRENCH LINER.

A new liner for the Havre-New York service is to be built in the St. Nazaire shipbuilding yards of "Chantier et Ateliers de Saint Nazaire Penhöet."

Its dimensions will compare with those of the " Majestic " and the " Ile de France " as follows:—

| | " Ile de France." | " Majestic." | New Vessel. |
|---|---|---|---|
| Length ... | 804 ft. 4 in. | 915 ft. | 900 ft. |
| Breadth ... | 93 ft. 4 in. | 100 ft. | 106 ft. |

It is anticipated that the new liner will be ready by 1932.

PARIS ENGINEERING CONGRESS.

The International Congress of Masonry and Reinforced Concrete Engineers is to be held in Paris from May 21st—25th, 1928. It is being organised by La Chambre Syndicate du Batiment, 3, Rue de Lutece, Paris.

PAIMBOEUF GRAVING DOCK.

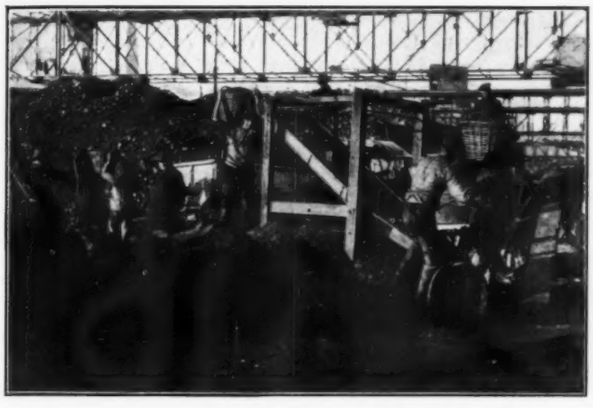
The Paimboeuf Graving Dock was let by auction on March 24th. The lease is for nine years.

PORT OF CALVI WORKS.

Contracts amounting to 847,000 francs were signed on March 31st in respect of dredging work and a 30-metres extension of the seawall at the Port of Calvi, Corsica.

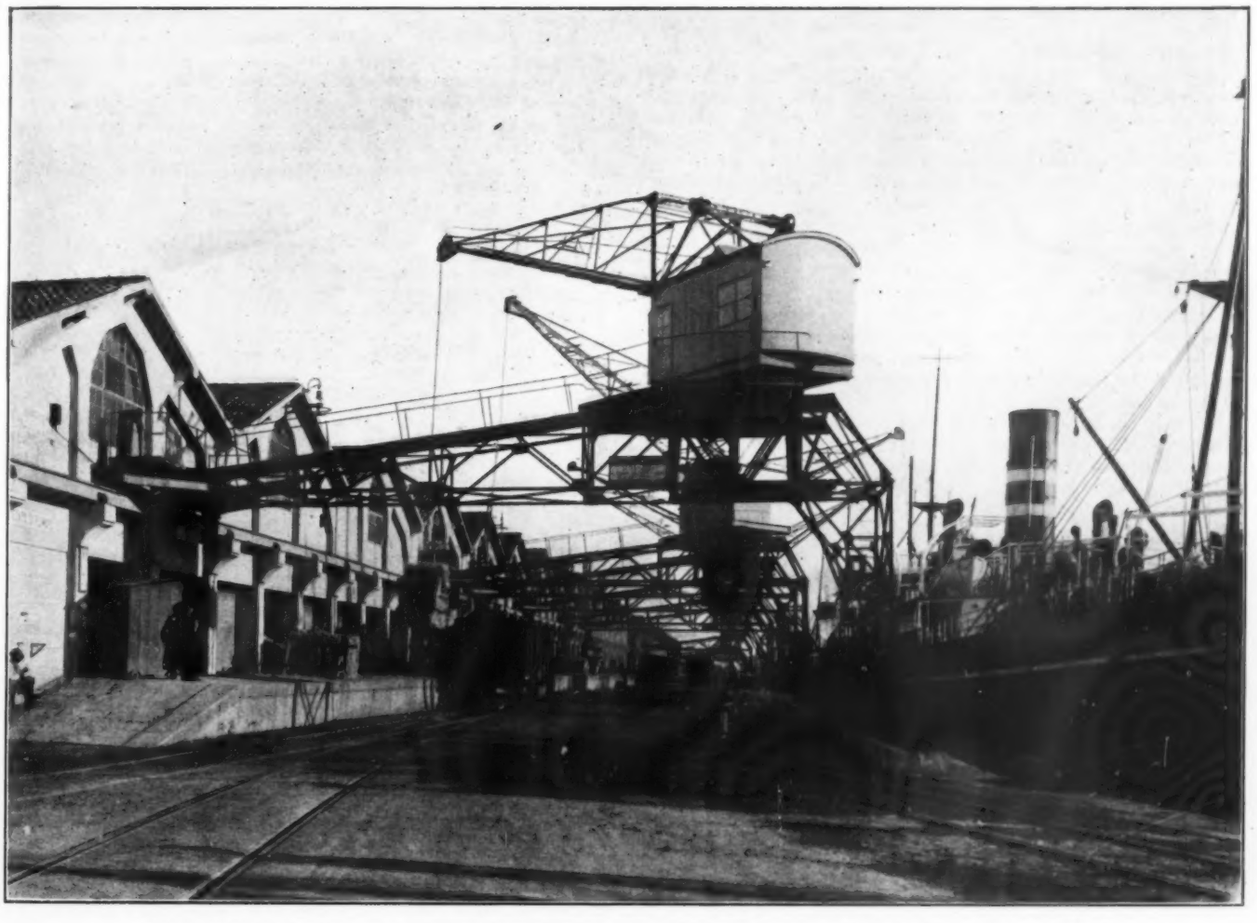
A Vessel in the completed Dock, Vittorio Emanuele III., at Genoa.

# The Port of Genoa.

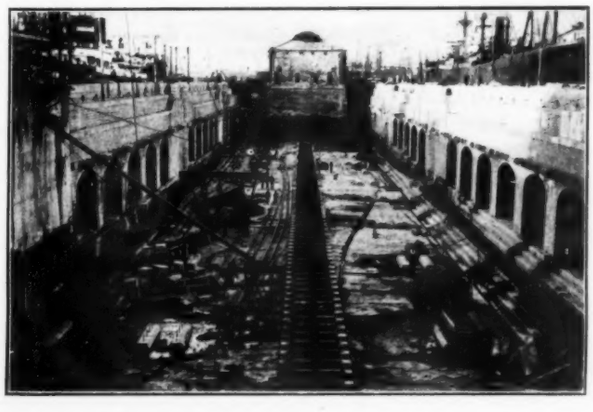


At Work on the New Dock, Vittorio Emanuele III.

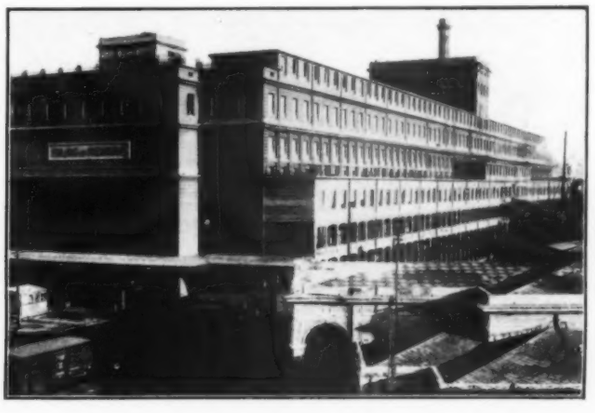
On the right is seen track for transporting material.
Vittorio Emanuele III. Dock.



A View of Quayside Plant at the Italian Port of Genoa. The Crane in foreground is unloading a Cargo of Wool.



Operations in Progress on the Dock Floor.



A View of the Grain Silos at Genoa.

# Alternating Current Motors.

## *The Application of Centrifugal Starters.*

The simplest and cheapest electric motors are those of the squirrel cage type, but, on account of their heavy starting current, which may be as much as four to six times the normal full load current, their advantages can only be fully realized for small outputs, up to about 3 K.W. For larger outputs,

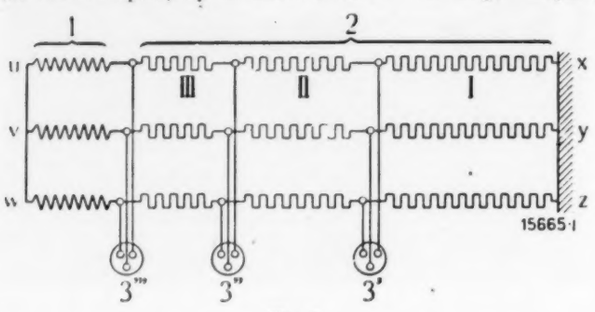



Fig. 1.

1—Rotor Winding. 2—Starting Resistances. 3.—Centrifugal Starter.

and when the regulations of the public supply company require it, even for outputs of less than 3 K.W., special apparatus is necessary to enable starting to be effected without the current peak exceeding the maximum allowed. Star-delta switches can be used for this purpose up to about 7 K.W., and for greater outputs auto transformers are generally employed. Both these devices, however, result in such a serious reduction in the starting torque, usually to about 30 per cent. of the full load torque, that for many purposes the motor cannot be used without the addition of further equipment making it possible to start up under light load.

On this account, slip ring motors with wound rotors and rotor starters are used in most countries for powers exceeding 3 K.W. Within certain limits, the starting current of these machines can be kept as low as desired and the starting torque adapted to the special conditions in force. These slip ring motors with the necessary starters are, however, dearer in the first cost and less simple in operation than a squirrel cage motor with star-delta starter, and are no cheaper than a squirrel cage motor with an auto transformer.

On this account many attempts have been made to develop a motor combining the simplicity and cheapness of the small squirrel cage machine with the more favourable starting current and starting torque of the slip ring motor and rotor starter. It is now claimed by the firm of Brown, Boveri and Company, that these ideals have been obtained in a motor equipped with a centrifugal starter.

The centrifugal starter, comprising rotor resistances and switch mechanism, is mounted on the motor shaft, with which it rotates. The rotor is usually wound as for an ordinary three phase slip ring machine, and the stator is quite normal. The rotor resistances are always cut out symmetrically step by step at the most suitable speeds under the action of centrifugal force. In Fig. 1 a diagram of connections is given for a rotor with three resistance steps per phase. For larger outputs, the resistance in each phase is divided into four or six steps. The three resistances X, Y, Z, are permanently connected to the neutral point. The switches 3 close automatically with the increasing speed in the order $3^{I}$, $3^{II}$, $3^{III}$, an equal

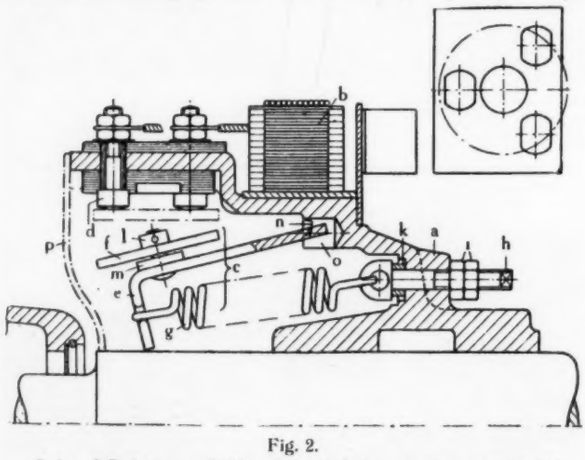



Fig. 2.

*a* Casing. *b* Resistance. *c* Switch. *d* Contact Studs. *e* Lever. *f* Contact Plate. *g* Spring. *h* Tension Bolt. *i* Adjusting Nuts. *k* Distance Piece. *l* Collar. *m* Washer. *n* Pivot Groove. *o* Hole for end of Lever. *p* Dust Cover.

amount of the resistance in series with each of the three phases of the rotor being cut out at each step. The neutral point thus approaches the rotor winding which is completely short circuited with the closing of switch $3^{III}$.

The centrifugal starter is mounted on the shaft in the place which in other machines is occupied by slip rings and short circuiting devices. It is protected by a stationary cover fixed to the bearing bracket. As shown in Fig. 2 the resistance element B is mounted on the outside of the body A, within which the switches C are fitted.

The resistance consists of a metal strip, insulated by heat resisting materials and wound on spirally under considerable tension, the whole being held in position by a sheath of binding wire.

The mechanical and dielectric strength is increased by a special impregnating and heating process. On the one side of the resistance the three terminals for the rotor windings are placed, the tappings for the switch terminals being on the other side. The outer neutral point is located in the casing of the starter.

According to the size of the motor, three four, or six switches are fitted. Each of these consists of three contact studs D attached to, and insulated from, the body A, together with a bent lever E, which carries a contact plate F and is controlled by a spring G. The tension of this spring can be adjusted by means of the nuts I on the bolt H, and the short distance piece K mounted on the casing. The contact plate consists of a flat copper disc, which is held between a collar L and a shock-absorbing washer M, so that it can be easily turned or adjusted. The two rounded feet of the lever E are situated in the groove N of the casing, while the central portion projects into the hole O. In this way, though its end is fixed radially and tangentially, the lever is free to rotate about N. For lower speeds the contact pressure is increased by additional weights fitted to the extremity of the lever. For higher speeds, in order to control the effects of centrifugal force, cast iron arms with double springs are used. For very high speeds, 3,000 and 3,600 r.p.m., two-armed levers with balanced weights are used. The general arrangement of a switch for a high speed starter of the latter type is shown in Fig. 3.

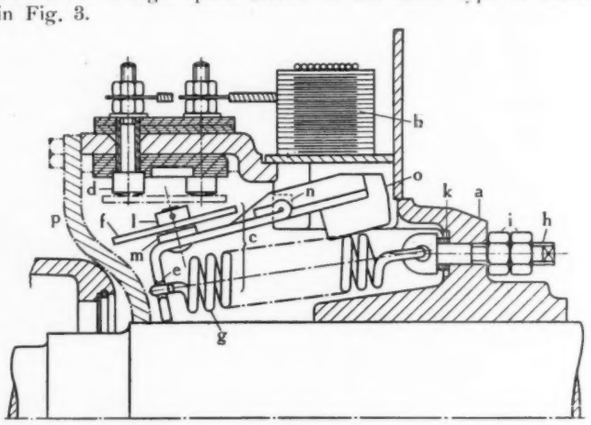



Fig. 3.

*a* Casing. *b* Resistance. *c* Switch. *d* Contact Studs. *e* Lever. *f* Contact Plate. *g* Spring. *h* Tension Bolt. *i* Adjusting Nuts. *k* Distance Piece. *l* Collar. *m* Washer. *n* Pivot Groove. *o* Balance Weight. *p* Flame-proof Protection.

The spring holds the switch open until its tension is overcome by the centrifugal force on the lever and the contact plate. The latter is then forced against the three contact studs D. The friction of this arrangement is practically nil, as only a single pivot is concerned.

The lever and spring are so dimensioned that after the switch has begun to move it closes with a snap. The contact plate, on account of its adjustability, strikes all three contacts simultaneously, any tendency to rebound being prevented by the shock absorbing washer M. On account of the ease with which the contact plate revolves, the points of contact are continually changing, thus the wear due to burning of the contacts is reduced, and the use of special contacts is avoided. The plate may, if necessary, be reversed and the underside used.

Motors of this type have proved successful wherever squirrel cage or slip ring motors of about 2-200 K.W. would otherwise be employed, with the exception of certain special cases, such as when excessive speed regulation is necessary. They are capable of replacing the squirrel cage motor in all cases where a star-delta starter or an auto transformer must be used, and also the slip ring motor with a separate rotor starter.

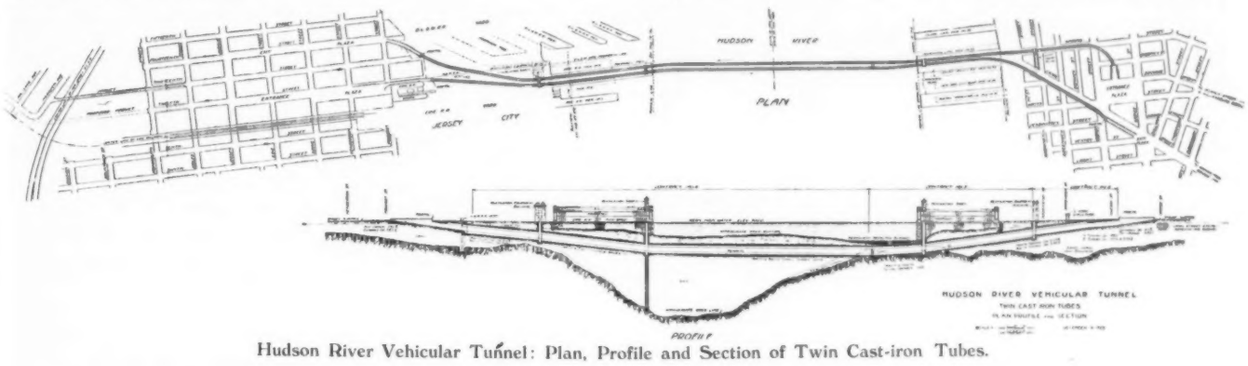
## FRUIT TRADE AT HULL.

The London and North-Eastern Railway have just issued an attractive folder entitled "Hull: The Fruit Centre of Europe," for distribution in Australia and New Zealand. The folder has a two-colour pictorial cover and mentions the exceptionally favourable position of Hull for the import and re-export of fruit; it also draws attention to the up-to-date equipment which exists at the port for handling this particular traffic. The folder is intended to point out to Australian shippers the advantages of sending fruit via Hull.

# Notes on the Hudson River Tunnel.

## INTRODUCTION.

The construction of the twin tunnels under the Hudson River, linking the two cities of New York and New Jersey, has been attended by several problems not previously encountered in similar projects. These problems are largely due to the large diameter of the tunnels, but the methods adopted by the engineering staff have been successful, and there is every prospect of the work being completed well within the scheduled time. It will be recalled that the tunnel will consist of two tubes, each 29 ft. 6 in. diameter, one being 8,282 ft. long and the other 8,366 ft. long. The tunnel lining is made up of rings 2 ft. 6 in. long, composed of fourteen segments and a key. The cast iron lining weighs 8.65 tons per lineal foot, and the cast steel lining 9.39 tons per foot. In each case the weight includes bolts and washers.




Hudson River Vehicular Tunnel: Plan, Profile and Section of Twin Cast-iron Tubes.

## USE OF COMPRESSED AIR.

All the ventilation shafts have been completely sunk, and six shields have been put into operation. This work has been entirely under compressed air with a maximum pressure of over 47 lb. The heaviest part of the compressed air programme has now been reached, and the continuation of the progress now being made will mean that tunnelling will very soon be entirely completed.

An interesting feature is the marked success which has been attained in reducing the dangers of working under compressed air. Every precaution has been taken to prevent compressed air sickness or ' bends,' with the result that there has not been a single fatality due to this cause, nor a critical case involving permanent paralysis. This is a record on work of this magnitude, and it is believed that the equipment and methods now in use have reached a point where loss of life due to this cause can be practically eliminated.

## PROBLEM OF SHALLOW COVER.

The starting of the shields out of the caissons at the New York land shafts has been difficult because of the large diameter of the shields and the shallow cover overhead. The material at this point is granular, consisting largely of fine sand, which if undisturbed holds air fairly well. As the shields were under the city streets it was impossible to increase the cover overhead. To avoid blowouts at the face with the consequent inrush of water, it was necessary to regulate the air pressure carefully and protect the face during each successive step in excavating.

As a preliminary step to shoving the shields out of the caissons, the circular steel bulkheads in the caissons were burned out in front of the shields. The work was done by removing the steel in horizontal layers, each layer being carefully protected as the steel was removed to avoid exposing a great area of the face to air leakage, especially when the air pressure sufficient to dry out the bottom would be heavy enough to cause a blowout at the top. Removal of the steel bulkhead was started at the bottom, with the steel above intact and with air pressure sufficient to dry out the bottom. After the lower third of the steel bulkhead had been removed, a wooden bulkhead was built in front of the shield and the space between this bulkhead and the ground in front was packed with clay. The air pressure was then reduced until it balanced the water pressure at the top of the shield and work was begun at the top, removing the top plates and proceeding downward. As these plates were removed breastboards packed front and back with clay were inserted to cover the exposed excavation. This work proceeded down to the point where the bottom plates had previously been removed, while at the same time the air pressure was raised step by step to balance the water pressure. The shield was then advanced against the wooden bulkhead at the bottom, compressing the clay, which was removed as the shield advanced, with the jacks reacting against the cast iron tunnel lining temporarily erected in the shaft.

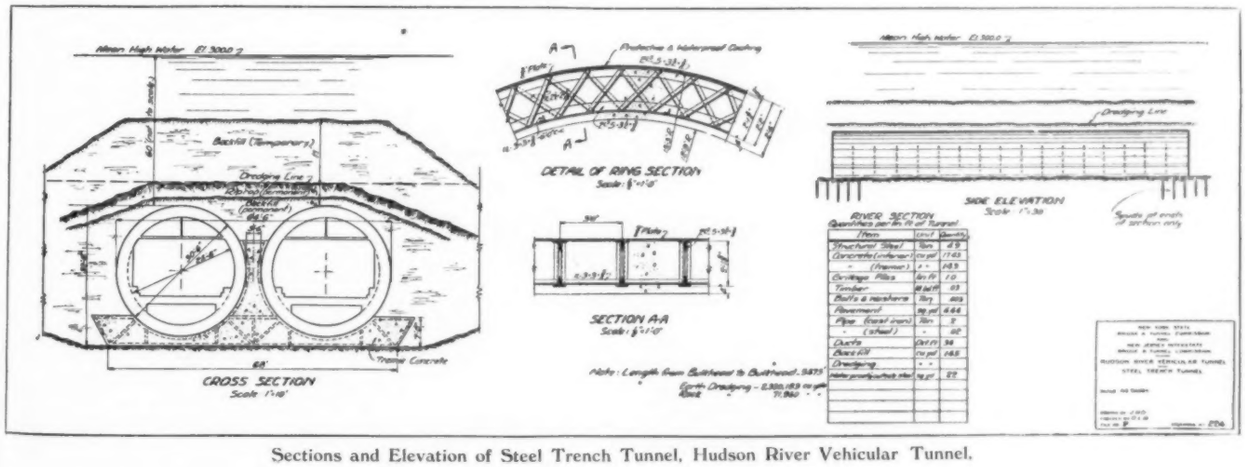
## PREVENTING AIR LEAKAGE.

In order to prevent leakage of air round the hood of the shield an annular pocket was excavated ahead of the hood the full length of a shove, and this pocket was packed with clay. This method serves a double purpose: First, the hood, as the shield advances, cuts into the clay and makes a thorough seal in front against air leakage; second, by exploring the full length of the shove assurance was had that the shield would not pick up and drag timbers in front of it, leaving open channels behind through which air could readily escape. The necessity for taking this precaution is evident when it is considered that at this point there was only 14-ft. of cover above the shield to the street surface, and only 8-ft. from the top of the shield to the underside of an old brick sewer.

As the tail of the shield left the caisson grouting was at once started to fill the annular space which the shield left outside the tunnel lining. Every effort was made to keep this space fully grouted, even to the extent of stopping the shield in the middle of a shove to keep the grout up with the shield.

The method just described was modified in some cases so that in the bottom quarter of the shield, instead of packing ahead with clay, a fixed wooden bulkhead was built in the shield, and the shield was advanced into the fine wet sand with the bulkhead in place. This compressed the earth, driving out the water, so that the material was firm and could be excavated during the shove over the top of the bulkhead, or through small openings cut in the bulkhead itself. This prevented a free run of material into the bottom, which is the ordinary method of tunnelling.

Preparatory to tunnelling under the river bulkhead, clay and other material to prevent the escape of compressed air from the tunnel were deposited in the slip between the piers, and on the landward side of the river bulkhead to fill such

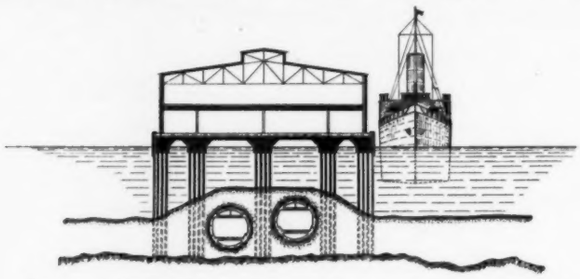



Sections and Elevation of Steel Trench Tunnel, Hudson River Vehicular Tunnel.

voids as might remain around the tops of the piles supporting the timber platform of the bulkhead construction.

### TUNNELLING THROUGH SILT.

In tunnelling through the Hudson River silt the front of the shield was completely bulkheaded, and some of the lower pockets in the shield were opened to allow part of the material to enter the tunnel as the shield was advanced, the balance of the material in excavation being displaced bodily. During the progress of the shield through the silt it was noticed that there was a tendency for the tunnel lining to rise behind the shield. The difficult feature at this point was that the shield was so heavy that it settled while the cast iron lining behind the shield rose, so that the shield was at all time below grade while the tunnel lining a short distance back was above grade. To counteract this the bulkheads in the shield were moved forward to reduce weight by lessening the amount of earth in the shield, and this aided somewhat in preventing settling and allowing more material to be taken in through the shield.



Section of Hudson River Vehicular Tunnel, showing relation of tubes to proposed pier.

In carrying the tunnel from the soft ground into the ledge rock particular care was taken to excavate well below the shield and repack with clay or some soft material so that any subsequent settling of the iron lining would not bring the structure to bear upon some projecting rock. When it came to the point where support must necessarily be directly upon rock, the iron was allowed to settle upon a concrete cradle with steel rails embedded in it upon which the shield slid.

### MUD AND TIDAL ACTION.

On the New York shaft no excavation was carried on in the working chamber until the cutting edge had penetrated about 9-ft. into the mud, as the weight of the caisson displaced the material up to this point. The upper half of the outside of the caisson, or the part exposed to open water, was covered with water proofing, which in turn was covered with an 18 in. layer of concrete. An additional protection is afforded in the upper portion by a granite facing where the shaft is exposed to tidal action.

The average progress in silt for a 24-hour day was 7.5 ft., and the average progress in sand 6.2 ft.

In tunnelling through soft mud a certain amount of material was taken in through the shield to hold the tunnel to the proper grade. Accordingly, the shield was advanced with the top pockets bulkheaded, and a large percentage of the excavation was permitted to enter the tunnel through openings in the lower part of the shield. This material had to be entirely removed after each shove before the erection of the cast iron lining could proceed, and slowed down progress. To meet this situation a new method of tunnelling was adopted. The work was stopped and a steel bulkhead semi-circular in shape and fitting into the lower part of the tunnel was built to trail about 10 ft. behind the shield, and the four pockets of the shield immediately above the springing line were equipped with hydraulically-operated doors. When the shield advanced, these doors were opened varying amounts, depending upon conditions, to allow the material to flow through the shield into chutes which dropped the silt behind the trailing bulkhead. This method permitted both the shield and the tunnel to be kept to the grade and a daily progress of 15 ft. per day of 24 hours was maintained.

The writer is indebted to Mr. Clifford M. Holland, first chief engineer of the Hudson River Tunnel, for the diagrams.

### HEAD OF FRENCH LINE HONOURED.

Mons. J. Dal Piaz, head of the Campagnie Generale Transatlantique, also known as the French Line, has recently been appointed to the rank of " Grand Croix " in the Order of the Legion of Honour.

### CONTRACT FOR SEARCHLIGHTS.

The London Electric Firm, South Croydon, Surrey, has received an order for some searchlights of extraordinary size, namely, about 7 ft. diameter. These are larger than anything hitherto built in Britain, and amongst the largest ever made in any other country. The searchlights will have a range of many miles.

## Shipping at Basle in 1927.

### *Influence of Favourable Water Conditions.*

The Department of Overseas Trade has received from His Majesty's Legation at Berne a report by His Majesty's Consul at Basle, regarding shipping at the port during 1927, when 774 vessels of 768,751 net register tons entered the port, this figure constituting a record for Basle Rhine Navigation.

The nationality of the vessels arriving were 234 Dutch of 235,982 net register tons; 208 German of 211,866 net register tons; 146 Swiss of 141,934 net register tons; 148 French of 139,430 net register tons; and 38 Belgian of 39,539 net register tons, all of which carried cargo.

As regards down-stream traffic, only 264 vessels of 250,651 net register tons carried cargo, the remaining 510 vessels of 518,100 net register tons being in ballast.

The following were the principal articles of import into Basle by the Rhine route during 1927, the quantities being in tons:—

Wheat, 152,791; maize, 64,076; oats, 38,934; barley and rye, 6,292; coal, 163,778; liquid fuel, 48,132; coke, 67,592; ore and various earths, 32,359; pitch, 16,822; cellulose, 12,736; phosphates, 12,702; iron and other metals, 7,270; sugar, 5,923; ground-nuts and oil-seeds, 3,212; briquettes, 2,165; sulphur (raw), 2,051; fodder, 1,878; paving stones, 1,297; railway material, 898; wood (various kinds), 664; other articles not specified, 13,493; total, 655,065.

The principal exports in tons from Basle via the Rhine during the year under review were as follows:—

Iron ore, 20,412; chemical products, 8,290; purite ash, 11,088; fodder, 3,917; asphalt earth, 9,962; condensed milk, 2,817; furnace slag, 1,844; leather meal, 1,206; iron alloys, 1,190; various stones, 984; nitrate of lime, 955; planks, 934; chloride of lime, 461; ferrous silicium, 112; potash, 4,766; other goods not specified, 5,637; total, 74,575.

The satisfactory traffic last year is attributed firstly to the high water level which prevailed for over six months of the year. In most years, snow reserves and normal summer rainfall suffice to maintain a navigable water level until the end of August. During last summer, however, the weather conditions were abnormally wet, August being the wettest in 64 years, whilst the continued wet weather in September rendered navigation possible until October, and this fully compensated for the shortage of snow water, which is generally an important factor in Rhine shipping.

In addition to the favourable water conditions, it may also be mentioned that the general improvement in the economic situation and the increased French railway freights, due to reasons of exchange, also contributed in no small degree towards the record traffic figures reached.

Personal enquiries regarding all shipping and transport matters should be made at the City office of the Department (Shipping and Transport Section), 73, Basinghall Street, London, E.C.2.

## The Distribution of Petroleum.

### *Tankers and Ocean Installations.*

Mr. W. M. Hurrell, in his chairman's address to the Junior Institution of Engineers, London, on March 16th, spoke on the subject of " The Distribution of Petroleum." The first link in the distribution chain, he said, was the tanker carrying the oil from the refinery to the ocean installation. The layout of the latter depended on the amount of trade, the site, and the national and local regulations, which were more stringent than formerly. Large storage tanks, Mr. Hurrell said, were usually of rivetted construction, but all-welded tanks of 10,000 tons capacity might yet be used. All-welded roofs were not uncommon. For preventing evaporation of lighter products, the latest development was the floating roof, which minimised air space.

Mr. Hurrell advocated the careful layout of pipe lines in order to give flexibility for handling and blending. He described the floating pipe lines used to carry oil to deep-water berths at Aden. Referring to pumping equipment, Mr. Hurrell said that centrifugal pumps, from the largest to the smallest, had been a complete success. He went on to describe sub-installations fed by barge or rail-tank cars, and the distribution from local depots, mentioning transport and selling methods in all countries, including those where tins eventually assume a value as cooking utensils and other articles of domestic use. Mr. Hurrell said that the " silver " covered dome of a mosque in a remote part of India was found, on close inspection, to bear the imprints of a well-known brand of kerosene.

The address was illustrated by a cinematograph film and many lantern slides, and was listened to by a large assembly of members and friends.

# Notes from the North.

## CONTRACTS FOR LANDING STAGE REPAIRS.

At the March meeting of the Birkhenhead Town Council, Mr. Forsythe objected to a proposal of the Ferries Committee that the tenders of Messrs. Gordon Alison & Co., of Birkenhead, for the repair of the landing stage for £8,595 and that of Messrs. Cammell, Laird & Co,, for the building of four new pontoons for £3,160 be accepted. He said that an arrangement should be made with Messrs. Cammell, Laird's as to the employment of men. When pontoons were made at the yard previously many boys were employed. The objection was not sustained.

## NEARLY THROUGH.

So close are the lower river headings of the new Mersey Tunnel, which are being driven through the solid rock from Liverpool and Birkenhead, that tunnel workers beneath the bed of the Mersey can now hear the muffled sound of blasting on the opposite sides. On March 10th the bottom headings were less than 200 ft. apart, and, provided the normal rate of progress is maintained, the contractors' men should meet early in April. The usual progress is about 40 ft. a week on either side, and the junction, when effected, will probably be in mid-river or slightly towards the Liverpool side. The upper river headings are not so well advanced as the lower, but good progress is being made, and it is expected that only a short time will elapse before the second junction is made. Work is also proceeding apace on the approach headings, and in Hamilton Square, test borings are being made by the Francois Cimentation Company to test the nature of the rock on the line of one of the approaches.

## POSSIBILITIES OF HILBRE ISLAND.

Is it possible to construct a harbour on Hilbre Island, which lies off the Cheshire coast, near Hoylake, and to link the island to the mainland, by a roadway from the Red Rock at Hoylake? Captain Wynne Williams, who makes this proposition, does not pretend to speak with the authority of an engineering expert, but he believes that from the end of Hoylake to the island, a distance of just over a mile, a foundation of rock may be found beneath the sand. The road, he suggests, should end at a spot where sluice gates can be provided for a harbour at the island. The opening between the three isles—Hilbre, Middle Island and Little Eye—should be walled up and then filled in with sand. Thus the proposed harbour would be one and a quarter miles long and a quarter of a mile broad. Captain Williams believes that by dredging near the Little Eye a sufficient depth of water could be secured to take a vessel of shallow draught and establish a ferry to North Wales, which, he considers, a better proposition than the suggested bridge from Wirral. The writer imagines that the enormous cost of such a scheme would immediately place it outside the pale of immediate practical politics.

## ALTERATIONS AT HEYSHAM.

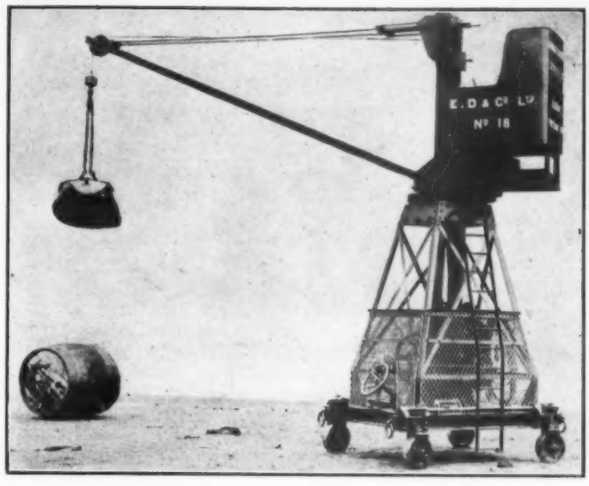
In preparation for the development of the steamboat traffic to and from the North of Ireland by the Heysham route, the cranes on the quayside at Heysham are being dismantled and reconstructed in more advantageous positions. In the meantime most of the goods traffic to and from Belfast and Heysham is being diverted through the Wyre port.

## MISHAP TO FLOATING BRIDGE.

In the course of a week many thousands of vehicles of all descriptions, motor propelled and horse-drawn, use the Liverpool floating bridge of the Mersey Docks and Harbour Board, to gain access to the vehicular traffic ferry boats to Birkenhead and Seacombe. Each of these bridges, which are of considerable length, is supported on floating pontoons, but it is only on very rare occasions that one of them fails under its heavy strain of tonnage. When such misfortunes do happen a serious hold-up of cross river traffic is inevitable. Such was the case a short time ago when a pontoon sank under the floating bridge. The pontoon was under the north side of the bridge near the landing stage end, and at the flood tide that part of the structure over the damaged portion remained depressed. A pump was set to work to clear the water, and meanwhile vehicles from all parts of the country made up a lengthy queue. Eventually the north side of the bridge was closed for traffic, but a slow and steady procession was able to move cautiously along the south side, while for light traffic the spare short bridge nearby was utilised. For some time the pump was again put to work, but little impression was made. The pontoon has since been taken away and replaced by a fresh one. Many motor drivers only moved away after being held up at the Pierhead for several hours.

## RHYL'S ALTERNATIVES.

Ratepayers of Rhyl have been exercising their votes for and against the discarding of the Council's £25,000 pier rebuilding scheme, in favour of the reconstruction of Foryd Harbour and the building of a pier there. There were 1,146 votes in favour of the Council's scheme and 780 against.




Type of Electric Crane used by Messrs. Elder Dempster & Co., Toxteth Dock, Liverpool.

## USEFUL TYPE OF DOCK SHED CRANE.

The proposal to instal electric cranes at the Barrow Docks brings to mind that Messrs. Elder Dempster and Co., the well-known Liverpool Steamship Company, has, at their Toxteth Docks sheds, Liverpool, a particularly serviceable type of portable crane capable of handling varied classes of cargo whether in barrels or bags. These cranes are of 5-cwt. load capacity, have a lifting speed of 70 cubic ft. per minute, and slewing 190 ft. per minute. They are operated by an electric motor of 2 b.h.p. capacity. This type of crane is of light but rigid steel construction, and is mounted upon four ball bearing road wheels. Suitable arrangements were made when these cranes were first put into commission, for electric connections to enable the cranes to be operated throughout the entire length of West Toxteth Dock shed—a distance of 450 yards, and within a radius of 30 yards from the respective electrical connections. The original intention was to provide for only twelve cranes to operate in this shed, but owing to their successful application in dealing with such cargoes as kernels, cocoa, cotton and the loading off on to wagons, the number has been substantially increased since the time the cranes were first introduced, about eight years ago. Perhaps in some future series of these notes the writer will make more extensive reference to the up-to-date electrical equipment at the West Toxteth dock sheds.

## PRESTON DOCKS PRESENTATION.

Mr. J. Barron, M.Inst.C.E., engineer and general superintendent, Preston Docks, on March 1st presented Mr. John T. Alston, who occupied the office of storekeeper in the engineer's department until his retirement on December 31st., with a wallet containing treasury notes subscribed by members of the dock staff and others connected with the Dock Estate. Mr. Alston thanked the staff and all connected with the undertaking for the many kindnesses shown to him during his 34 years' service. He recalled the fact that when he first entered the service the main imports were wheat and log timber. The equipment and facilities then provided were nothing compared to the present time, the Corporation having only 12 wagons of their own as against the present 260. The hydraulic cranes available were five, whereas now there are 14, and the steam crane equipment was, in those days, very meagre indeed.

## LLANDUDNO SEA PROTECTION WORKS.

Sea protection works on both the north and west shores at Llandudno, to cost £11,637, have been authorised by the Llandudno Urban District Council. In connection with the sea protection works, it is proposed on the Llandudno Bay shore to build three groynes of a special design "Crib" type in lines curving gradually towards the Great Orme, and to construct concrete aprons and steps, the total cost being estimated at £6,413. The suggestion of a sea wall to raise the height of the defences on a portion of the Llandudno Bay coast is left in abeyance. Exposed surfaces and slopes of sand dunes are to be protected by the planting of Marran grass. This west shore scheme will involve an expenditure of £5,224.

Mr. W. T. Ward, surveyor and engineer, in his report to the Council, points out the difficulty of foreseeing the results of any particular type of protective works. Hence at the outset some work of an experimental character, but of sufficient extent to give it a fair chance of attaining definite results, should first be undertaken. Dealing with Llandudno Bay, the engineer observes that the bay is, of itself, unfit for consideration, as the two headlands are composed of rock which is not subject to wastage. The direction of the drift is from west to east. This is evidenced by the piling of shingle at the easterly end of the bay. The shingle travels largely from the west shore of Llandudno Bay, and as the Great Orme is an effective "cut-off," preventing further supplies from coming in, there is a continual

wastage of the beach. The problem is how to retain what shingle is left to retard the travel eastward of such accretion as may come from west of the pier, and to hold a certain quantity of the shingle which, with light east winds, tends to travel back from the direction of the Little Orme.

It is pointed out that on the West Shore (the Conway estuary), where the shore winds are of greater strength and frequency, and the currents altogether different, the more apparent erosion began about 1916. The first defence works were built in 1921. Of the flat area of the Promenade the maximum width lost by sea encroachment is 103 ft. and area 1.71 acres.

**DOCK GATE MISHAP.**

A peculiar mishap occurred recently at the entrance of the Prince's half-tide dock, Liverpool. As is usual at high water, the gatemen prepared to close the river entrance dock gates, but a fender having become wedged, they would not shut, with the result that on the receding tide, the water in Prince's Basin passed into the river. There was a danger of the steamer "Wheelsman" coming to rest uncomfortably on the bottom. She had just finished discharging 7,000 tons of cement, and a hurried attempt to work her into the East Waterloo Dock was carried out successfully. Here, also, misfortune was in store, because the gates, keeping a high level of water inside, had become stuck. A diver had to descend to free the obstruction and the "Wheelsman," along with other craft in the East Waterloo Dock, became safe. Although the half tide water had reached a level below the height of the abutting docks, the steady flow through cracks, later, enabled it to reach suitable height, once the outer river gates had been closed.

**MERSEY SALVAGE SUCCESSES.**

Heavy duties have devolved upon the Salvage Department of the Mersey Docks and Harbour Board recently, and in the space of four months six large liners and four small vessels have been in peril. Mr. Charles Livingston, chairman of the Marine Committee, at a meeting of the Mersey Docks and Harbour Board, called the attention of the Board to the valuable salvage services which had been carried through by Captain F. W. Mace, O.B.E., R.N.R., the marine surveyor and water bailiff, and his assistants, Captains Hart and Harbord, and their staff. They had had a very strenuous time and had done splendid work. During that time they had dealt with the following salvages:—"Lochmonar," "Seminole," "Zealand," "Jennie," "Pensarn" and "Varand," and also four smaller vessels in the docks. These salvages had meant the exercise of a great deal of skill, danger and hard work, and they were all successfully accomplished. It did great credit to the department and he was quite sure that he was expressing the feelings of the Board in tendering to those officials the warmest appreciation of their services.

**MORE FACILITIES FOR FLEETWOOD.**

Important alterations and additions to the sidings outside Wyre Dock Station are comprised in the £100,000 scheme which has been outlined by Sir Iosiah Stamp, president and chairman of the L.M.S. Railway Company. The reconstructions to be undertaken at the sidings, include the reorganisation of the railroad adjacent to the engine sheds, so as to enable locomotives to run direct to the sheds. The shunting decks near the marsh are also to be enlarged and additional sidings laid down just beyond the footbridge at Burnhaze, for the accommodation of about 500 wagons. One of the principal features of the scheme is the laying of another set of metals along the east side of the fish stage, to enable fish trains to run direct on to the main line. It will be appreciated that when the trains can run direct from the dock to the main line, there will be a considerable saving of time.

**JETTY TO BE DEMOLISHED.**

The greater part of the Central Pier jetty, Blackpool, is to be removed. At one time there was a regular service of pleasure steamer sailings from the pier, but the gradual accumulation of sand, by some attributed to the training walls in the Ribble, has made the jetty impracticable for sailings for a number of years. So the jetty has become useless and has cost more to maintain than it earns in revenue. The low-water jetty, which is roughly two-thirds of the total length of the jetty, has been sold for a nominal figure to Messrs. Maden, McKee & Co., of Liverpool, and the work of demolition will soon be taken in hand.

**IMPORTANT CONTRACT FOR BRITISH FIRM.**

The Port of London Authority has entered into an important contract for a period of ten years with Tilbury Contracting and Dredging Company, Limited, for conveyance to sea of the material dredged in maintaining the navigable channel of the River Thames from London Bridge to the Lower Hope.

This Company has for the past thirty-six years been continuously engaged upon somewhat similar work under the Port of London Authority and its predecessors, viz.: the conveyance to sea of the material dredged in maintaining the depths of the various docks in the River Thames, to which work the new contract just entered into will be an important addition.

# The Calcium-Silicate Brick Process.

## *Utilising Boiler Ash and Clinker for Building.*

The calcium-silicate or sand-lime process, for construction work, continues to make considerable progress in Great Britain. Boiler ash, clinker and similar material can all be made into high-class bricks on the same lines. At the present time over 12 "Sutcliffe-Speakman" plants are in operation, representing an output of about 250,000 bricks per 24 hours, and the firm now have plants under erection at Bournemouth and Glasgow. Since the introduction of the process in 1894, plant and equipment has been erected all over the world. Recent installations are the Standard Sand Co. and the Mansfield Sand Co., both at Mansfield, near Nottingham, the Arun Brick Co., Ltd., at Littlehampton (Sussex) and Bolckow Vaughan & Co., Ltd., Middlesbrough, using blast furnace slag.

The method consists essentially in mixing sand with 5—10 per cent. of its weight of good quality lime which has been thoroughly slaked so that no trace of quicklime is left, together with a small amount of water. Afterwards the plastic mass is passed through a continuous brick press, such as the "Emperor," and subsequently the shapes heated in a long iron cylinder or autoclave for, say, 4—8 hours by blowing in steam at 120—180 lbs. pressure, resulting in a chemical combination between the lime and the sand to form hydrated calcium silicates.

This binds the mass together, giving an intensely hard, smooth brick, resembling natural building stone, which has the advantages of the ordinary burnt clay brick in strength, durability and porosity, whilst there is no sign of bulging, warping, and twisting. Every brick is a "facing" brick. In the case of boiler ash and clinker, however, steam at atmospheric pressure only is sufficient, using a long brick or concrete tunnel, the bricks being a deep bluish colour, while the sand lime brick is a very light grey, handsome in appearance with a smooth grain. With ash and clinker, blast furnace slag, spent shale, or other products the lime combines with the free silica or unsaturated silicates present, but the reactions are much more rapid than in the case of sand, which is essentially pure silica (Sio 2).

# Kiel Canal Traffic.

## *Ice Conditions cause Decline.*

A report received by the Department of Overseas Trade from His Majesty's Consul-General at Hamburg states that the noticeable decline in traffic through the Kiel Canal during January, 1928, compared both with December, 1927 and with January of last year, is attributed not only to the usual seasonal decrease, but also to ice conditions during the past month which rendered navigation difficult. Compared with January, 1927, there was a decrease of about 700 vessels, aggregating 130,000 tons, passing through the canal, and compared with last month, there was also a marked decrease of some 820 vessels, aggregating roughly 370,000 tons, the actual figures being as follows:—

| | No. of Vessels. | Net Reg. Tons. |
|---|---|---|
| January, 1928 ... | 2,836 | 1,231,905 |
| December, 1927 ... | 3,657 | 1,600,901 |
| January, 1927 ... | 3,514 | 1,362,667 |

Of the 2,836 vessels in January, 1,896 were registered as sea-going steamers and aggregated 1,115,575 net reg. tons, and 32 vessels aggregating 27,748 net reg. tons were sea-going motor ships. These two classes include 1,659 freight and passenger steamers aggregating 1,221,141 net reg. tons, 71 fishing steamers aggregating 4,994 net reg. tons and 159 steam tugs, aggregating 7,097 net reg. tons. In addition there were 695 sailing vessels of 39,310 net reg. tons and 212 lighters and barges of 49,235 net reg. tons. The vessels were loaded as follows:—Three with passengers, 141 with coal, 23 with stone, 37 with iron, 144 with timber, 343 with grain, 12 with cattle, 362 with ore and other bulk goods, 966 with piece goods, 51 with general cargoes and 754 empty or in ballast.

During January vessels with cargo have decreased in proportion to the decreased traffic. General cargo alone was able to maintain its previous level. The number of fishing steamers using the canal again shows a considerable increase, whilst sailing vessels impeded by ice conditions have fallen off markedly.

Personal enquiries regarding all shipping and transport matters should be made at the City Office of the Department (Shipping and Transport Section), 73, Basinghall Street, London, E.C.2.

**ALGIERS HARBOUR TENDERS.**

Tenders were recently invited for the building of a seawall, 445 metres long, and the reclamation of 11,800 square metres at Port de Delleys, Algiers.